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The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

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SEPTEMBER, 1951

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PRESIDENTIAL ADDRESS

TWENTY-FOUR YEARS WITH THE TASMANIAN DEPARTMENT OF AGRICULTURE — A REVIEW OF SOME OF THE WORK

By F. W. HICKS

Before reviewing the work of the Tasmanian Department of Agriculture during the last twenty-four years, it is necessary to go back beyond that period and endeavour to ascertain the position of agriculture, and to estimate if there was any justification for the remedial measures considered and initiated by the government at that time.

COMMONWEALTH PROPOSALS FOR REMEDYING THE FINANCIAL POSITION OF TASMANIA

Perhaps the best starting point is a conference of Commonwealth and State Ministers held in Melbourne in May 1926, to consider the financial relations between the states and the Commonwealth. The Commonwealth Government made a considered statement under the heading of Commonwealth Proposals for remedying the financial position of Tasmania. Extracts from this statement are:—

(i) In considering this matter it must be recognised that the Commonwealth cannot assume responsibility for the varying degrees of prosperity and development of the several states arising from their geographical position.

(ii) The mere taking of a money grant is not the solution of the problem. Such a grant is in effect contributed by the several states of the Commonwealth, and it is proper for the Commonwealth Government to consider the obvious fact that the mere granting of money, far from removing the causes of the trouble may, in fact, increase them. The true aim, therefore, is to discover the causes of the financial difficulties and to seek to provide means for their removal. If, for example, the difficulties are due to arrested development, the essential problem is to determine how development may be promoted in order that increased production may lighten the burden of taxation and render further enterprise possible. It is from this point of view that the requests of Tasmania and Western Australia have been approached by the Commonwealth Government.

(iii) The only effective remedy for this unfortunate position is to increase the production of the Tasmanian community. An increase in production will lead to an increase in revenue, particularly from the railways, without increasing the real burden upon the people. In order to explore more thoroughly the causes of deficient production and to propose methods of overcoming the present retrogression, the Commonwealth Government

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F. W. HICKS, H.D.A., is Superintendent of Extension and Technical Services of the Department of Agriculture, Tasmania. *The above article is based on his Presidential Address to the Sixteenth General Meeting of the Institute, held on 21st and 22nd May, 1951, in Brisbane.*

is prepared to make available the resources of the Development Commission about to be set up, and of the reorganized Bureau of Science and Industry, so that a full and scientific investigation may be made.

(iv) These proposals are made by the Commonwealth Government with the sincere desire to assist the State of Tasmania in overcoming the difficulties which at present exist. The Commonwealth Government is satisfied that the difficulties can be overcome by resolute and determined efforts made in the light of full knowledge of the relevant facts and in pursuance of an enlightened and progressive policy.

THE REPORT OF THE DEVELOPMENT AND MIGRATION COMMISSION

The Tasmanian Government accepted the proposals for a full investigation and on August 20, 1926, the Prime Minister requested the Development Commission to investigate the present position in Tasmania and recommend any methods in which assistance could usefully be rendered in that state.

Early in the investigations it became clear that the position of the agricultural industry was so serious that immediate steps for its improvement were considered essential. The more enlightened people engaged in agriculture in Tasmania and those associated with the industry were realising that the advancement in methods and the intelligent, practical application of scientific knowledge would materially improve the conditions of the agricultural industry in Tasmania. With this realization it was thought the position should undergo a marked change and lead to permanent improvement if not complete restoration.

The investigating authority recommended that to effect essential improvements it would be necessary to cover three functions, namely:—

(i) Extension of scientific knowledge among farmers.

(ii) Finance.

(iii) Marketing.

The first step, viz., extension of scientific knowledge, must precede the other two. This step, the Commissioner considered, could best be achieved by the immediate strengthening of the Department of Agriculture. This Department in 1926-27 consisted of: Director, three officers in the Farm Crops Division; Poultry Supervisor; three officers in the Dairy Division; Horticulturist; Veterinarian; Agricultural Chemist; Plant Pathologist; Clerical Staff; Staff assistants; and Stock and Port Inspectors. The estimated cost of the Department at that period was £19,512.

The strengthening recommended was to increase the Department by the addition of the following: Research Division, Animal Husbandry Division, Entomologist, Farm Engineer, Apiarist, Agricultural Economist, Home Economist (Female), Seed Testers.

It is also proposed the establishment of an Extension Service with a Superintendent on the headquarters staff and five decentralised District Extension Officers.

It was estimated the staff increases visualised would increase the annual vote on agriculture by £18,000 per annum. The total estimated cost of the Department during 1927-28 was £37,500.

This was an enormous sum of money to spend on agriculture and at that time the expenditure was very freely debated by Parliament. The total expenditure on Agriculture today is:

Department of Agriculture, £224,500.

Miscellaneous; Minister for Agriculture, £284,500, thus the total costs of the Department of Agriculture are approximately £500,000.

REORGANIZATION OF THE DEPARTMENT OF AGRICULTURE

The Department of Agriculture was reorganized in 1927-28, five District Extension Officers being appointed with

about the same number of District Veterinary Officers. The technical side of the Department was strengthened in some respects.

The Development of the Agricultural Extension Service

The first function of the newly established Extension Service was to investigate the type of agriculture practised in various parts of the State, obtain an appreciation of the illness from which agriculture was suffering and design a policy of agricultural improvement which in effect meant curtailing farming activities designed to deplete soil fertility and encourage types of agriculture designed to increase fertility.

At this period Tasmanian agriculture was at a low level. It was essential to arrest the decline and institute better farming methods. The District Extension Officer was primarily responsible for improving the system of agriculture. This involved the moulding of public opinion. Agricultural apathy was combatted, a spirit of hopefulness created and a recognition of the virtues of the new teaching acknowledged by the farming community. During this period when the work was very strenuous, it was common for the work of the Department to be attacked in the press. Travelling expenses and salaries of officers were quoted in the press and in the early years of the reorganized Department, individual workers appeared to be fighting against tremendous odds.

The scene today has changed, however, and the District Agricultural Officer is now firmly established and is regarded by the farming community as the officer responsible for agricultural advice and farm planning work in his territory. As this work developed and public demand increased it became necessary to enlarge the organization, and about twelve years ago the Extension Service was remodelled on a divisional or regional basis, with a Senior Agricultural Officer acting as a co-ordinator of all extension activities in his region. Each region consists of four or five agricultural districts.

In addition to the normal advisory work associated with a district, the Extension Service in this State is also responsible for all the field work associated with the Agricultural Bank and the Closer and Soldier Settlement Departments.

Such an organization should be possible in the larger states of the Commonwealth if constituted authority in such states were not opposed to a change. In my opinion, however, it has the distinct advantage of only one agricultural policy operating in the state. The organization has worked well in Tasmania and by the adoption of a system of comprehensive and economic reports relating to individual properties and supervision of the expenditure of advances made available by the banking authority, it has been possible to make finance, the handmaiden of agriculture, whereas the reverse position operated for many years in most states of the Commonwealth.

There is obviously a limit to the amount and the scope of work a decentralised extension officer can effectively perform, and his most effective field appears to be associated with farm management, farm production costs and general advisory work. The increasing complexity of scientific agriculture makes it almost impossible for the extension worker to keep abreast of the various research findings, even if he is adequately supported by his technical colleagues in the various fields of research. On this assumption it would appear that what was considered a good extension organization some years ago may not fully meet the position today. Consequently, means of keeping the results of research before the farming community is a matter of prime importance, and it is necessary to think of methods of achieving this desirable state. One appears to be the appointment of extension specialists, on a regional basis, in such fields as entomology, pathology, etc.

Further advances have been made in recent years in connection with extension service work in the education of youth.

Area Schools

A system of Area Schools is well established in Tasmania and when fully developed will total about 35 schools. The Government has now agreed that all agricultural education in area schools will be under the control of the Department of Agriculture. This opens up a very large field for future extension work, the value of which can be estimated only in the future.

The Junior Farmer Movement

The Junior Farmer Movement is now establishing firmly in the State, and although a State Executive Committee controls the activities of this movement, the actual work associated with the clubs is the responsibility of the Department of Agriculture. As far as extension work is concerned, the Department of Agriculture is responsible for the straight run of agricultural education from the area schools to the adult farmers of the State.

A stage has now been reached in Tasmania when the extension team in each district consists of a District Agricultural Officer, Assistant District Agricultural Officer, District Veterinary Officer, District Dairy Officer, Stock Inspector, and in some cases a Certification Officer. It is apparent from the volume of the work that in many areas the staff will have to be strengthened at an early date.

Aids to extension workers

You are all familiar with the various aids used by extension workers. In recent years much emphasis has been placed on the value of films as a means of visual education and their value is very good indeed. The making of a film for agricultural education is not an easy matter, and it requires far more than good photography. The professional photographer to my mind is more concerned with taking good pictures with a desirable background rather than taking a shot that contains an extension story.

The writing of script is a professional job, but the professional script writer is seldom trained in agriculture; consequently the real extension truths are often missing from an agricultural film. No attempt is being made to deprecate the use of films, but films to be useful and convey the extension lesson to the rural community should be written and directed by a trained agriculturalist. Another point is that unless an organization has unlimited funds at its disposal, the number of films that can be made is limited by the cost.

Tape recorders and microgroove records

A new useful aid to extension work is the tape recorder and microgroove record. The microgroove disc cust 224 lines per inch and a 13 in. record on both sides can be used for 45 minutes of constant talk. The cost of each disc is about six shillings.

By the use of the tape recorder, discussions in the field, such as field days, and interviews with farmers concerning a special activity on the farm can be recorded. These recorded interviews can then be transposed on to the microgroove record and by appropriate photography and synchonization of voices and photos an excellent film can be produced. The big advantage is that the cost of such a production is only a matter of a few pounds compared with hundreds of pounds for a talking film.

By the utilization of this method it is possible to take the farms to the people, and from an extension point of view it is better to have a couple of farmers telling their own story — and of course it is the story you want them to tell — than to have two departmental officers telling the same story.

Extension aid is now being developed in Tasmania and it opens up a very large field, not only for the extension worker, but also for the research officer as it enables him to discuss matters relating to

research and is a method of placing the results of research before the farmer.

Increasing efficiency of the potato industry

During the early years of the reorganized Department of Agriculture, the Tasmanian potato industry was in a very bad condition, so bad that the two main commercial varieties in the state, Brownell and Bismark, looked as though they were faced with extinction. This actually happened prior to 1927 with a very popular variety known as the Brown's River Red or Redskin. Even at that time it was recognized that seed grown under severe high altitude conditions had developed a stronger and more robust constitution resulting in a higher cropping capacity when transferred to more temperate conditions. The fact of a higher proportion of healthy plants resulting from comparative absence of insect vectors and disease had so far not been recognized.

Potato Seed Certification Scheme

During 1927 work was commenced with the object of retrieving the industry from the serious position into which it had drifted. At the outset the establishment of a seed certification scheme was entered upon by using commercial crops with the highest degree of health and vigour then existing. The venture proved to be entirely unsatisfactory and was discarded. Other methods were at once adopted.

The first step was to obtain the co-operation of Brownell growers throughout high altitude inland districts in which reputable crops were known to occur.

During 1928 a survey of many crops was made, the object being to select healthy foundation stock as a basis for certification and to remove the tubers from plants judged to have a standard of good health sufficient to warrant further attention.

The collected seed was then grown at a place called Myrtle Bank with adequate isolation and an altitude of approximately 2,000 feet above sea level. Individual selections were grown separately and for two seasons subjected to extremely critical examination.

As a result of this work some selections were discarded, some heavily rogued and others only lightly rogued. After two years, trial seed quantities from the most promising selections were moved back to Hampshire on the North West Coast where an area of basaltic soil at high altitude existed. This is the class of soil in which the Brownell variety thrives and produces best.

In 1932 the remainder of the stocks were transferred from Myrtle Bank to Hampshire.

A further advance was made in 1934 through selection, during the growing period, of 1,250 single plants. The progeny of each was grown separately during the following season and critically examined under a system of points allotted for each principal character in type and health relating to both aerial and underground growth.

For several successive years this system was continued until at last the original 1,250 plant lines were reduced to four families each of medium and late Brownell.

The four families of each strain have been retained and annual selections from them constitute the main elite seed production upon which seed certification is based.

The important early variety Bismark did not come within the scope of the Department until 1933 when the first small quantity of seed from a Midland source was introduced to the Tewkesbury Potato Research Station.

In a relatively short period of time departmental officers working in close co-operation with officers of the Commonwealth Scientific and Industrial Research Organization were able to produce virus X free material for the certification scheme. Today, practically the entire state crop has its origin in this stock.

The same kind of selection work has been successfully undertaken with the Up-to-Date and Pink-eye varieties. Potato seed certification in Tasmania passes through a number of progressive stages before the seed is finally released to the commercial grower.

The first stage is the production of Elite Seed at the Department's Tewkesbury Potato Station. At this station current production is on the original basic principle of the multiplication of selected plants. A favourable report on a selection means that it is multiplied through progressive stages on the Foundation Area, the first Multiplication Area, the second Multiplication Area and finally to the bulk crop stage and then released from Tewkesbury. The various multiplication stages under supervision cover a period of seven years before release to commercial seed growers.

The second stage is Mother Seed production. This is undertaken by selected high altitude potato growers who purchase Elite Seed from Tewkesbury and produce the crop under departmental supervision.

The final stage is the production of Certified Seed. This is undertaken by approved high country farmers who buy from Mother Seed growers and sell their produce to commercial growers.

This work has completely rehabilitated the potato industry in Tasmania and the Certified Seed has a high yielding potential, provided other factors such as soil fertility, are satisfactory.

The amount of Certified Seed produced annually is between 50-60,000 sacks.

It is admitted that there has been a concentration of work in the main varieties, but the possibility of the introduction of new selections or hybrids has not been overlooked, and a great deal of co-operative work with hybrids has been undertaken with C.S.I.R.O.

Work associated with seed certification has not been entirely confined to the potato industry.

Pasture seed certification

During the year 1932 it was realised that there was a great scope for the initiation of a pasture certification scheme. The work obviously had to begin in a small way, but over the years it has developed and today pasture seed certification work covers a fairly wide field, such as: Perennial Ryegrass, Italian Ryegrass, Short Rotation Ryegrass, Sealed Ryegrass, Subterranean Clover and White Clover.

Certification of cereals

Certification work has also been extended to cereals and the work is conducted on much the same lines as potatoes. The mother seed is produced at Cressy Research Farm and after release is grown by selected growers under departmental supervision.

Certification work with cereals includes Braemar Velvet, Major and Pinnacle varieties of wheat; Algerian and Sir Douglas Haigh oats; and Plumage Archer, Golden Archer and Goldthorpe barley.

The yields fluctuate, but the average production of Certified Cereal Seed is 20,000 bushels annually.

A selection of Algerian oats made some years ago at the Cressy Research Farm has over the years demonstrated its ability to recover after feeding off, and give a better final yield. As demand for this oat is increasing annually, certification will have to be expanded fairly rapidly.

A certification scheme for the production of virus free strawberry plants has been in operation for many years and annual releases of this material are about 100,000 plants.

Soldier Settlement

Anticipating the need for soldier settlement, the Department conducted research work on areas of land in the State. This land was previously held in small areas of freehold, and large areas of leased Crown Land. The lease conditions are such that the holder of the lease has little fear of ever losing it, consequently this

type of land has in the past been held in large areas, and in one section of the State an area of approximately 300,000 acres is involved. The investigational work conducted over the past 10 years has been so successful that an area of approximately 100,000 acres is now being developed for soldier settlement.

The administration of soldier settlement in Tasmania is carried out by the Agricultural Bank, but all the field work, including purchase negotations, purchase and operation of clearing equipment, development of the areas, farm design and many other activities associated with bringing country from an undeveloped condition to farm maintenance areas, is carried out by Extension Service officers who have been seconded to the above authority.

The total area acquired for the purpose of soldier settlement is 1,437,000 acres, and at the present time negotiations are proceeding for a further 115,000 acres.

Veterinary services

As mentioned earlier when the Department was reorganized in 1927, the veterinary section was strengthened to some extent by the addition of three district veterinary officers who were expected to give a complete state coverage.

During the year 1935 three additional veterinarians were appointed.

In 1942 the number had increased to ten, and it was during this year that a scheme for the nationalization of veterinary services was introduced in Tasmania. It must be acknowledged that the scheme was introduced because of the deficiency of veterinarians in private practice in the state.

It is safe to say that Tasmania is the only state in the British Empire to have such a scheme operating. It is doubtful if any similar type of scheme operates in any part of the world.

The operation of the scheme gives fairly complete satisfaction to the farming community, but examining it in a critical way from a departmental viewpoint, it must be recognized that officers tend to concentrate on the more important clinical work at the expense of investigational work that should be consistently followed by the department. In order that investigational work should be placed in its right focus, two veterinary officers are now concentrating on this type of work.

Brucellosis: The control of brucellosis was commenced in 1933, the only known method of control between that time and 1943 being test and slaughter.

At the end of 1948 a remarkable degree of progress had been made. The southern section of the State was clean, the north-eastern section nearly, Flinders Island was clean, but the north-western section of the State was still giving some trouble.

In 1949 the policy to be adopted was reconsidered and it is now the determined plan that where more than 10 per cent. of the herd are reactors, strain 19 vaccine is used on all calves and the culling is not done until the end of the lactation period.

If the percentage of reactors in a herd is less than 10 per cent. then the test and slaughter method is still used.

It may sound an extravagant claim, but in respect to the control of this particular disease the position in Tasmania is better than in any country in the world.

The present establishment of the Animal Health Service of the Department is 18 veterinary officers and 18 stock inspectors, and it is recognized that to adequately cover all activities associated with research work and nationalization demands, the total number of veterinarians should be 28.

Rabbit control

As a result of recent legislative action, the control of the rabbit pest has now been vested in the Department of Agriculture. For many years the control of this pest, which offers a severe challenge to agriculture, was the responsibility of municipal councils and the mere fact that

it was considered necessary to take the control away from local bodies indicates the amount of work and the success that has been achieved in the past. An organization is now being established in an endeavour to give effect to the desire of Parliament.

THE DEPARTMENT OF AGRICULTURE IN 1951

When the Department was reorganized in 1927, the equipment was very meagre. The passage of years has helped in bringing about a definite change and the position has been reached today when the Department is fairly well staffed with trained people and well equipped laboratories are available for workers in their respective spheres.

The Department in common with all other departments in the Commonwealth now has well equipped veterinary, entomological, pathological, dairying and seed testing laboratories.

The field investigational work is also catered for by research farms, and the Department now controls: The Tewkesbury Potato Station; The Cressy Research Farm; The Elliott Research Farm; The Summerleas Horticultural Station and The Grove Orchard Research Station. The Elliott Research Farm and the Grove Orchard Research Station are two recent acquisitions of the Department, and are at the present time being developed further.

It is impossible in an address of this character to touch on all the activities of the Department. If any of the statements made sound like "Gilding the Lily", I apologise, but at the same time say with candour that it is only by hearing, seeing and comparing the work of other people, altering and changing the technique of such work to fit a new set of conditions, and by giving young workers full scope to display energy and initiative that real and lasting agricultural progress can be made.

It must be acknowledged that many remarkable advances have been made, but the scene today is one that is constantly changing, and will continue to do so, provided that those people who control the destiny of the Commonwealth realize the full significance of the importance of food during the next 50 years in Australia. If such a realization is present it must follow that there will be an appreciation of the wisdom of making available adequate funds to enable research and extension work to be pursued by the Commonwealth and the various states.

(*Received for publication June* 18, 1951.)

ARTICLES

THE M.I.A. EXPERIMENT IN AGRICULTURAL EXTENSION

By JOAN TULLY

The Murrumbidgee Irrigation Area's experiment in agricultural extension is going to be of great interest and importance to all of you in the future. You are all agricultural scientists. The basic reason for your work is to improve Australian agriculture. You may say that you carry out your researches because of natural curiosity or to get your pay envelope each fortnight, but the money in that pay envelope is really a measure of the recognised need for more information for agricultural development and progress. You agricultural scientists uncover the facts and enumerate principles on which new farming practices are based, but it is the farmers who have to adopt the new practices and use them. On the one hand is the farmers' need for information and on the other the information uncovered by your researches. "Extension" is the name we give to the channel connecting information with need.

Every major modern agricultural nation in the world has overhauled its extension service in the past decade. The U.S.A. was the first country to evolve a modern extension service which is kept constantly under review. Canada, Britain and South Africa have all found it necessary to adopt modern organization and modern methods to bridge the gap between the farmers' need and the mass of information turned out by research men.

In the next decade or so Australia is going to have to increase her primary production very considerably to feed her increasing population brought in by our immigration policy. This will be particularly necessary if we are to keep our export markets on which we live. There is much talk of the lack of men and materials for this increased production, but there has been no talk so far of another basic lack — the farmers' lack of the scientific information and what the Americans call "know how" to increase production. You agricultural scientists have a great deal of this basic information but the farmers have not. This is why I want to tell you about the Murrumbidgee Irrigation Area's experiment in giving farmers this basic information so that they can increase production.

Now, first of all I'd better give you some historical background so that you may understand some of the forces that have been at work.

History of the Murrumbidgee Irrigation Area

The first water came on to the farms in 1913, but little development took place till after the 1914-18 war. In the 1920's the M.I.A. became a soldier settlement, and large scale plantings were made. The clearing and development costs were

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charged to the farms and they all started with large debts. By the time that the orchards came into full bearing the depression hit them. Debts could not be paid off and were written down, but still the debt load was heavy. The farmers knew little about the correct methods of irrigation. By the end of the 1930's water tables were high and salt was beginning to become a problem. Then in 1939 there was an extraordinarily wet winter and autumn, the sort that comes once in 100 years — and with it a disastrous flood. Twenty per cent. of trees died. All the Jeremiahs were prophesying disaster. The M.I.A. was finished.

The crisis brought out the latent leadership from the people. A joint conference was arranged between the farmers and all the interested government departments, Department of Agriculture, Council for Scientific and Industrial Research, Water Conservation and Irrigation Commission and the Rural Bank. They all decided to put in money to have a survey made to find out the extent and exact nature of the disaster. This was the first successful attempt at farmer-State-Commonwealth co-operation.

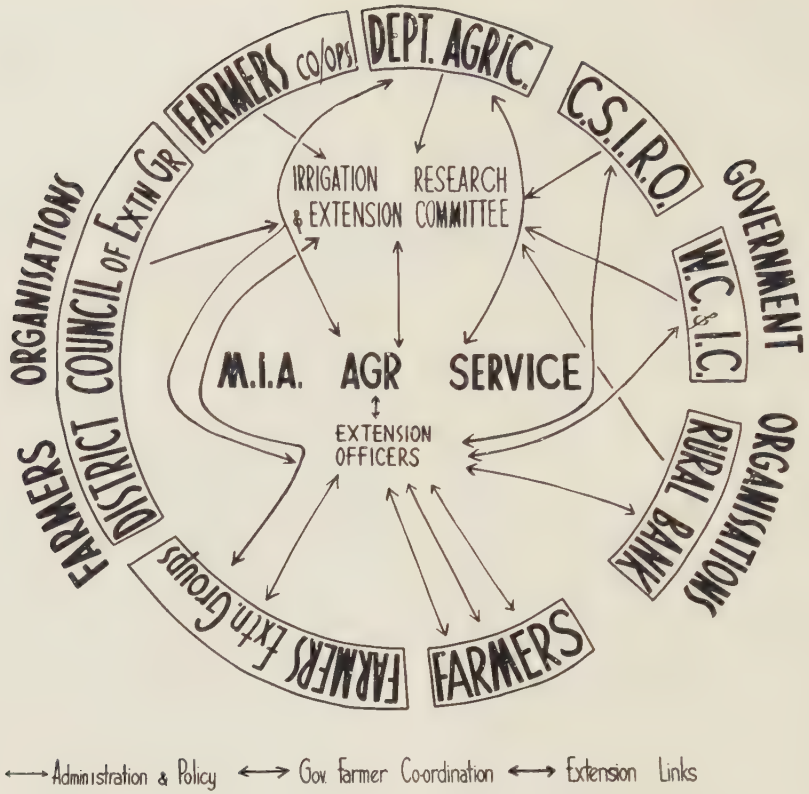
The Soils and Irrigation Extension Service

From this survey — aerial survey followed by ground survey — it soon became apparent that irrigation — poor irrigation — was the fundamental problem. All parties accepted this as the basic problem. The C.S.I.R. Irrigation Research Station had the basic information to right the situation, but the farmers had not. The farmers asked the Department of Agriculture to send a man to the C.S.I.R. Research Station to get the necessary information and pass it on to them. This was never done, so then the farmers asked C.S.I.R. to set up an extension service of their own to teach them the correct irrigation methods. Eventually the Department of Agriculture asked C.S.I.R. to set up such an extension service for a three year trial period as a war emergency. The subject matter was restricted to soils and irrigation. So the Soils and Irrigation Extension Service was formed and staffed by C.S.I.R. men who had been doing irrigation research.

This service was paid for jointly by the farmers, C.S.I.R., Water Conservation and Irrigation Commission, Rural Bank and the Department of Agriculture, and supplemented the normal Department of Agriculture service to farmers. The policy of the Soils and Irrigation Extension Service was controlled by the financing bodies through a Committee which was 50 per cent. farmers with a farmer in the chair. This new service adopted all possible methods of teaching — films, news articles, broadcasts, demonstration plots as well as field days, meetings and farm visits. They organised the farmers into groups in each district to learn and discuss. It was intensive adult education on a special subject which was of vital interest to those taking part — and there was active participation. For instance, once we prepared a pamphlet on Better Ditches and Grades. We had the draft roneoed and sent round to all the farmers' groups for comment and criticism, and we got it. One group of farmers declared that they could make an earth ditch better than we could, so they came round to the Research Station and demonstrated — and they could too. So their method was written in the pamphlet, which is now approved by the extension people and by the best farmers of the district. Of course, it was not all like this. There were plenty of farmers who did not hold with these new fangled ways. We were teaching our grandmothers to suck eggs. Hadn't they been irrigating for 20 years! However, as time went on the Soils and Irrigation Service got the confidence of the farmers. At the end of the three years' trial the farmers wished the service to continue.

The Murrumbidgee Irrigation Area Agricultural Extension Service

However, two separate extension organizations working in one district were not



satisfactory from anyone's point of view, and it was eventually decided that a joint organization should be set up under the Department of Agriculture called the Murrumbidgee Irrigation Area Agricultural Extension Service (see accompanying diagram). The old Soils and Irrigation Extension Service staff were seconded to this new service, and it also had staff from the Department of Agriculture. It was again financed jointly as before. This was the beginning of the Regional Service. It retains its local finance and its local advisory committee. As you can imagine, grafting a new regional branch, experimental in character and with some independent means on to an old established and highly centralised organization like the N.S.W. Department of Agriculture was not accomplished painlessly. There have been many creaks and groans, and many heart aches, but it has been accomplished.

What is extension work?

Now I dare say that many of you know what extension work is in a general way, but have no very clear picture of just what is involved. Extension is an expressive word and means exactly what it says — the extension of ideas, principles and methods to the people who can use them.

Farming is primarily a family enterprise; changes in methods lie with the individual farmer and his family. Extension work aims to promote efficiency, thus increasing production and the economic return from the farm. This means a higher standard of living for the farmer and his family, and ultimately a more prosperous state, nation and world.

Extension work does not mean only the bringing of laboratory results to the farmers. It is a living process in which there is a two-way flow of ideas. The principles worked out in the laboratory

must be adapted to local conditions, and this can most rapidly be achieved by drawing on local experience. The extension worker also learns from the farmers in his district what experience has shown to be the best practices, and his job is to skim the cream from local experience and see that this knowledge is used more widely among all the farmers.

A typical day in the life of an extension officer

Perhaps the best way to describe to you just what extension work is and the sort of thing an extension officer has to do is to take a typical day's work and describe that to you.

All the officers in the M.I.A. Extension Service are what we call General Practitioners. We deal with all farm problems in our own districts and we deal with farms as a whole. When we are stumped we call on a specialist for help, and many of us have our own specialities. For instance, mine is Home Planning and Housing problems, other officers are experts on pruning or making films, farm wood lots or earth moving and so on. But to get back to a day's work.

It is no 9-5 sinecure of a job. The telephone usually starts ringing about 7.30 a.m. First perhaps a call from the Ballingall Group Secretary to say that they are having supper at the meeting that night and can I bring along the cups. Then one from Arthur to say he is irrigating and can I come out and help him run some trial flows. He has a young orchard on very permeable soil with flat slopes. Really ideal for furrow irrigation, but he has only just bought the place and has not yet learnt to irrigate it. Then a couple of reminders from me to District Council representatives about a meeting tomorrow. It is important that they should be there. There is to be a discussion on Red Scale control and also on ways to overcome the case shortage. It is easiest to catch farmers near the telephone first thing in the morning. Sandwich in a bath and breakfast and call at the Water Conservation and Irrigation Commission Office for a map of the district water table for the meeting tonight. On the way I get bailed up by Jim from out Bilbul way. He wants a copy of the "Septic Tank for Farms" bulletin, so I make a note to send it to him and tell him he can hire the forms for the concrete work of the tank from the Service for £3 with a £10 deposit. He can get the forms from the Health Officer at the Shire Office.

At last I get out to the office. There is a telephoned reminder of a library committee meeting tomorrow night, and a note asking me to ring Bill Jones. He wants to know if it's too early to put on a septoria spray at the end of February, and if he can use the Bordeaux with oil.

Then our Journalist and Publicity Officer, Al Grassby, comes bouncing into my office to know if I can suggest a topic for one of next month's broadcasts. Is there a farmer in my district who has been doing anything special lately? He particularly wants another farmer in the programme. Well, yes. There is Romano. He put in tile drains last spring, and is very pleased with the results. I shall give him a ring and see if he will give a broadcast. His English is pretty good, and I think he would be all right on the air.

I sit down to write up some notes on a couple of farm visits I paid yesterday, and answer a letter to a man who wants to know if the plan of a house he has sent me will be suitable for the climate. At 10.30 a.m. I have promised to be out at Arthur's farm to run those trial irrigation flows down the furrows in his block of citrus. When I get out there he has had water in some furrows for two hours and the flow has only just reached the end of the furrow. The penetration when we test it, is over 3 feet at the top of the row and about 6 inches at the bottom. We try several flows and eventually get the water to the bottom of the run in 15 minutes and get 18 inches of penetration all the way. We are both delighted with ourselves and go up to the house for a cup of tea. While

we are drinking it Arthur's wife asks me what I should do if I had her kitchen. It is the general passageway of the house. It has four doors and a stove set cornerwise. It also has a dresser and the table where we are drinking our tea is in the middle of the room obstructing all movement. There is a fair sized pantry opening off the kitchen. If the wall were knocked down between the pantry and kitchen you could make an excellent L-shaped work area there. This plan is immediately scheduled to be done next winter after the irrigation season closes.

And so back to the office to make some notes for tonight's Group meeting. I am showing a teaching film we have made called the "Importance of Flow in Furrow Irrigation". We usually give a short 10 minute introductory talk linking the film to the particular problems of the district where it is shown and have a discussion afterwards based on some slides that I must pick out from our collection. If they can be choosen to show farms in this particular district so much the better.

The case history of a difficult farm

At 2 p.m. an appointment to pick up a valuer from the Rural Bank and take him out to one of my farmers. This farmer inherited the farm from his father. The father, in his old age, had neglected the farm — he could not speak English and found it hard to get advice. The boy had not worked on the farm but had a job elsewhere. The farm was in debt and would not keep two families. The farm is still in debt. He owes the bank about £700 and nothing much has been paid off the debt for years. The farm is in very poor shape. The ditches need remaking, the headlands are hollowed out and the footlands have been built up by erosion over the years. The irrigation furrows are all hills and hollows and it's a nightmare to water. Efficient irrigation is impossible. It would take about £200 to put the place in order from an irrigation point of view. There are high water tables due to poor irrigation throughout the farm, and in places salt is showing and damaging trees and vines. Some of the plantings need replacing because of age and some are uneconomic because of poor condition. I have been working with this farmer for six or seven months now. He first called me in because some vines were sick. It was salt. Together we have explored his water table position, proved how uneven his irrigation is and put in two new ditches. I took the levels and told him how to make the ditches. He saved a crop of apricots by using oil pots to heat on frosty nights and it paid him handsomely. It was the first crop he has harvested in five years. All this has built his confidence, so that he was willing to discuss his financial position. The upshot was that he asked me to discuss the problem with the bank manager. The young owner and I have made a five year rehabilitation plan for the farm. First get the land back into good order for irrigation, save the apricot crop by heating, give the citrus enough nitrogen, plant up some vacant land and then when the land is in good order begin progressively pulling out the old planting and replanting. This is the plan we are going to put up to the bank valuer. Well, we walked that poor man over every inch of that farm that afternoon and showed him just how his asset was going to vanish before his eyes unless the reconstruction work was done. We got the extra money for the work. There is very little irrigation land in Australia, and what there is is much too valuable to be allowed to go out of production for want of proper handling.

We need good extension workers

Now, the point of this story is this. Although this farm is in very poor shape the soil is one of our best producing types under skilled handling. The extension officer's job is to build the farmer's confidence in his advice and to build the confidence of the bank managers and such people in the soundness of his advice and in his ability to get the farmer to follow this advice. Basically this all comes back to the professional and personal integrity

of the extension officer. There are times when he must say — no, this is a hopeless case; to spend more money on this farm is only throwing good money after bad. If he does not know the cause of a certain trouble he must say so and try to find some one who does or can help. This is how problems for research are picked up. Integrity and an honest desire to help people are as important ingredients in the make up of an extension officer as is sound scientific training. Extension work is fascinating work, rewarding work, and work which needs men of the very highest calibre and of great experience. It is vitally important both to the progress of agricultural science and to the progress of farming in Australia. It is the Achilles heel in Australian agricultural progress. You, the agricultural scientists of Australia — the men with training, imagination and vision — are the people to take the initiative and strengthen the weak link.

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THE PRESENT STATE OF SOIL SCIENCE

By C. G. STEPHENS

Soil science as we know it today had its origin in Russia in the work of Dokuchaiev and his colleagues in the latter part of the nineteenth century. This new approach to the study of the soil, with its recognition of Great Soil Groups correlated with major climatic zones and its emphasis on the interaction of the various soil forming factors, did not reach Western Europe and North America until early this century, and Australia until about 1925. Now, after twenty-five years of effort in this continent by Prescott and Piper and the staff of the Division of Soils of C.S.I.R.O. and in individual Australian states by Teakle, Burvill, Leeper, Penman and others, it is appropriate to look at the state of soil science both in general and with an Australian perspective. Thus we may attempt to specify the more obvious gaps in our knowledge.

Two major aspects of soil science have emerged from both the older and newer concepts about soils. The more fundamental is pedology which, briefly, is the science of soil formation and which includes within its framework a taxonomic approach to soil classification. Classification is the essential link with the second major aspect, agronomic soil science, which deals with the relationships between soils, plants and fertilizers, and is generally more empirical and experimental than pedology.

In attempting this assessment of soil science it was found most convenient to construct the accompanying diagram and to centre the discussion around the various soil forming processes shown thereon; then to deal briefly with the various soils formed as a result of the operation and integration of these processes; and finally to discuss soil classification as outlined in the table presented herewith both from the philosophical angle and as a means of providing basic information about the soil for agricultural, engineering and other purposes.

Physical weathering

So far as is known in a qualitative way physical weathering is a function of temperature gradient and conductivity of soil parent material, with plants and ice in certain circumstances playing a more or less important role. All that is known of this subject has been available for at least fifty years and in fact is well epitomised in Merrill's old work "Rocks, rock weathering and soils." There is obvious scope here for both field and laboratory studies aimed at giving precision to our knowledge about temperature gradients and physical stresses in rocks of various types.

Chemical weathering

Because of rapid advances made in the last twenty years largely with the aid of the X-ray spectrograph, the electron microscope, differential thermal analysis and associated chemical studies the whole concept of chemical weathering, ionic exchange and clay mineral structure in soils has undergone profound alteration. The hypothetical idea of an amorphous gel-like clay particle with its ionic double

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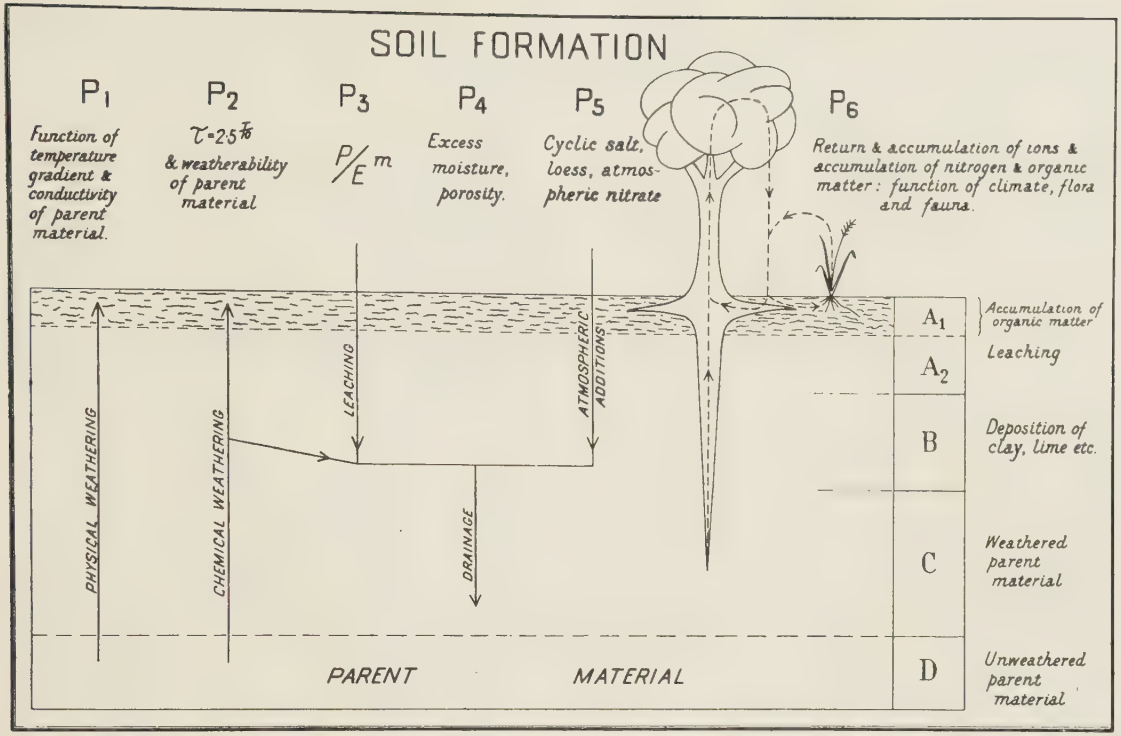

layer has been replaced by ultramicroscopic and other evidence of layered crytalline and other shaped particles with ionic exchange properties determined by the edges of and spaces between the fixed or moveable layers and by ionic radii. The various types of clay such as montmorillonite, illite, kaolin and hydrated alumina and other substances such as soluble salts, lime, gypsum, etc., produced by chemical weathering have been arranged by the U.S. worker Jackson as an index of weathering series. Thus our knowledge of the mode of formation of the substances found in soils and their relationship to climate is being advanced quite rapidly.

The study of the climatic factor in relation to weathering is, in the case of temperature, facilitated by the use of the index $T=2.5^{\frac{T}{10}}$ proposed by the Polish worker Szymkiewicz. This index, based on van't Hoff's law governing the rate of chemical reactions, taken simultaneously with a qualitative scale of the chemical weatherability of rocks provides an explanation of the occurrence of Red Loams from temperate to tropical regions. Obviously a more precise knowledge of rock weatherability would be a great help in these studies.

However, an equally significant dearth of knowledge in this field relates to those substances going into solution, either to be lost to the soil altogether or retained at different depths in the profile or in soils in adjacent sites: the solution of silica and the nature and formation of siliceous crusts and hardpans is a case in point.

Leaching

Because of the conviction that soils are more closely correlated with climate than with any other factor responsible for their formation, leaching, as manifested by soil morphology in relation to rainfall, has received more attention than any other process of soil formation. The search for a modified rainfall factor has been assiduous and fruitful. Prescott's

factor $P/E^{0.7}$ at the moment represents a satisfying step in these investigations. Following this, the obviously profitable field is the investigation of local variations in the effectiveness of this factor as modified by other soil forming factors such as parent material and relief. From this should emerge a clear understanding of local soil series and type patterns.

Drainage

Where an excess of soil moisture is available and the profile is sufficiently porous, drainage takes place. Under these circumstances the soluble products of chemical weathering and other materials such as cyclic salt are more or less efficiently removed from the profile. Where porosity is low or ground-water naturally occurs this process may be modified by the presence of a water-table which may have both vertical and lateral components in its movement. The loss by leaching of both organic and inorganic substances from the soil profile is largely a function of either one or both the above phenomena. Apart from lysimetric studies in Europe directed largely at estimating the loss of cations and nitrates from the soil and incidentally useful studies by drainage engineers, this is a seriously neglected field, particularly in Australia where apparently there are no published records of lysimeter studies.

Atmospheric additions and subtractions

The addition of both soluble and insoluble materials to soil in association with rain or as a veneer of dust of varying thickness has been a profitable subject for investigation in Australia. The addition of cyclic salt derived from the sea has been studied in some considerable degree but there is a significant lack of data regarding the variation in the annual intake with distance from the sea and rainfall magnitude and concerning the rapidity of loss by drainage or rate of accumulation where leaching is ineffective. This data is required to add finesse to geographic and genetic studies of soils which are now either salty, solonetzic or solodic, and is of likely significance in agronomic salinity problems particularly as determined by the natural upward or downward trend of salt concentration.

Soluble nitrogen compounds from the atmosphere are added by rain to the soil in generally minute amounts. European and African data show that under industrial or tropical conditions these amounts may be appreciably larger and possibly of ecological significance. There are no similar data relating to this phenomenon in Australia. It would seem a simple and profitable matter to obtain such data.

Loessial dust, probably largely calcareous in composition, has, according to Crocker, been added to parts of the Australian landscape in sufficient depth to provide the parent material of the Mallee or Solonized Brown Soils. It is very likely, on the basis of some evidence of unusually high pH values for some podzolic and solodic soils and even the presence in some localities of lime in the subsoil of such soils, that this veneer of calcareous dust may have been in certain places no more than a top-dressing of the original soil or, if initially thicker, been reduced to such dimensions by erosion.

The deflation of fine particles as dust from the surface soils of arid regions is a common phenomenon in desert soil formation. The presence in Australia of both stony and sandy desert soils owing their origin essentially to such a process is in conformity with their occurrence and genesis in other arid parts of the world.

Biological activity

Biological activity in soil formation is largely a neglected field, nowhere more than in Australia. Since the phenomenon is complex, involving as it does, plants, animals and micro-organisms, and since these factors differ very significantly from continent to continent, it is obvious that investigations are needed on a world-wide scale. The rather unique character of the Australian portion of the biosphere calls for particular effort here.

The results of such investigations are basic to an understanding of the accumulation of organic matter and nitrogen in the soil and the accumulation of ions such as calcium and potassium in surface soils. The widespread neglect of this field of investigation has paved the way for undue public interest in and partial acceptance of the odd mixture of half-truths and unproven claims of the group of people generally referred to as "composters" but more picturesquely described by Wadham of Melbourne University as "the muck and mystery school."

Soil formation

The joint effect of the six processes outlined above is the soil profile in its various forms. Early in the history of soil science Dokuchaiev formulated a function of the soil forming factors in the equation $P=f$ (K.O.G.V.) where P stands for soil, K for climate, O for organisms, G for sub-soils and V for age of the land surface: and he specified that interaction between the factors was involved. Recently, Jenny in his book "Factors of Soil Formation," used the equation $s=f$ $(cl, o, r, p, t. . . .)$ in which s is soil, cl climate, o organisms, r relief, p parent material and t time: apart from s he specified these as independent variables, whereas in fact only time is truly independent. Wilde in his book "Forest Soils and Forest Growth," added reality to these equations by integrating the effect of the factors against time in the equation $S=\int (g.e.b.)\,dt$ in which S is soil, g is geological substratum, e environmental influences, b biological activity and t time. The author by specifying the degree of interaction between the factors C for climate, O organisms, R relief, W water table and P parent material indicated fully the implications of the formula $S=\int f(C.O.R.W.P.)\,dt$. Thinking in terms of soil forming processes rather than soil forming factors we could similarly formulate the equations

$$S=f(P_1P_2P_3P_4P_5P_6) \text{ and}$$
$$S=\int f(P_1P_2P_3P_4P_5P_6)\,dt$$

and from the above we may infer, for example, that $P_2=f(C\,O\,W\,P)$. It is this simultaneous and interacting operation of the soil forming factors in each of the soil forming processes which indicate quite clearly that emphasis in the investigation of the soil forming processes is as necessary as in the case of the individual soil forming factors. In fact Jenny's recent investigations of the organic matter content of Columbian soils indicated that, despite a hypothetical independence, climate and organisms could not be so regarded. Again, as indicated earlier, the successful establishment of the reasons for the existence of Red Loam soils from Tasmania to North Queensland depended on the simultaneous consideration of climatic and parent material factors. Hence a strong plea is made for more emphasis in the investigation of the soil forming processes.

Soil classification

In the accompanying table is shown in briefest outline the scheme of classification of soils most widely accepted today. It centres around the original recognition of the Great Soil Groups by the Russians and to a similar degree around the Soil Series which have emerged primarily from the detailed soil survey of the U.S.A. The acceptance of this classification is purely tentative with distinct reservations about a number of features. As indicated, the most intrinsically sound taxonomic categories are Great Soil Groups and Soil Series, the first representing the readily discernible broad regional and continental geographical groups of soils separated from each other usually by a significant degree of inflection of their morphological characteristics, comparable in fact with that shown by the various races of man. At the Soil Series level the soil classes are those found in the soil pattern of farms and fields largely associated with changes of parent material, topography and drainage status, generally comparable in objective existence to the different genera of plants and animals.

VI. ORDERS	V. SUB-ORDERS	IV. GREAT SOIL GROUPS.	III. FASCS (Families).	II. SERIES.	I. TYPES.	O. PHASES.
2 classes	7 classes	40-50 classes.	Large No. of classes.	Very large No. of classes.	Possible 25 odd per series.	Any number desired
PEDALFERS (Acid soils)	Acid peat soils	e.g. High Moor Peats				
	Organic, sesquioxide and clay B horizons.	e.g. Podzols				
	Sesquioxide and clay B horizons.	e.g. Red Podzolic Soils.				
	Sesquioxide and clay A and B horizons.	e.g. Red loams				
PEDOCALS (Alkaline soils)	Organic A and calcareous B horizons.	e.g. Black earths				
	Calcareous B horizons.	e.g. Red brown Earths.	Belalian	Urrbrae	fine sandy loam loam	shallow normal deep
				Belalie	sandy loam loam clay loam	
			Canowian	Canowie	loam clay loam	
	Calcareous and gypseous B horizons	e.g. Desert loams.				

DETERMINANT ATTRIBUTES.

Presence or absence of lime and/or gypsum.	Nature and position of horizons.	Color, salinity and texture of profile.	Structure depth and consistence of horizons.	Parent material.	Texture of A horizon	Nature of any selected feature

← TAXONOMIC → ← ARBITRARY →

INCREASINGLY DETAILED RELATIONSHIP TO LAND UTILIZATION →

Of the other categories Marbut's abstraction, the Orders, composed of Pedalfers and Pedocals is generally regarded as intrinsically sound, but, because of a distinct overlap of Pedalfer characters into the Pedocals, it is difficult to use in that transition range: redefinition can probably overcome this defect; and a further advantage may accrue from the creation of a third class within the Soil Orders to accommodate the saline and post-saline soils at present very awkwardly situated in the Great Soil Groups. The Sub-Orders, despite the lack of appropriate nomenclature are patently morpho-genetic and hence probably largely sound in conception. The category Fascs or Families has been, and remains, a bone of contention with perhaps most emphasis in the establishment of its classes on the degree of development of the soil profile and the structure and consistence of the B horizon. The category Soil Types is definitely arbitrary in its classes being based on surface soil textures which are established on different bases of mechanical composition in different countries. Texture variation is certainly objective enough but its classification is not only seemingly necessarily somewhat arbitrary but also unfortunately not on a uniformly accepted basis. However there is some evidence worthy of closer investigation, both from the field and the laboratory, that texture variation can be sufficiently inflected so as to fall into discreet classes within the Soil Series. The Huon series of southern Tasmania is a pertinent example. The category Phases which really lies outside the classification scheme proper is frankly arbitrary, being used largely to establish classes on the basis of observed or assumed agricultural characteristics.

This latter approach to soil classification has unfortunately been used by a number of workers to vary the Soil Series and Type concept depending on the scale and purpose of the survey. Consequently in some soil surveys these classes are in fact crop adaptability classes rather than taxonomic units based on a proper consideration of soil morphology. The proper derivation of the determinant attributes of the different classes in each of the categories and the realization that the soundest and most comprehensive approach to soil classification must be on a taxonomic and morphological basis, is really necessary if classification is to be both sound and of maximum use in all appropriate fields including agriculture and engineering. Usefulness of soil classification in agriculture and the establishment of the increasingly detailed relationship to agriculture from Soil Order to Soil Type is obtained not by definition but by correlation.

It is useful to remember analogously that botany has become established as a science in its own right and that agriculture has lost nothing thereby, rather has it gained. Similarly pedology with soil classification should be established as an independent discipline, removed from being regarded as the hand-maiden of agriculture. Perhaps the desirable status of the natural sciences can be adequately indicated by a facetious illustration: donkeys like carrots; but certainly Linnaeus did not use this fact in establishing the present system of plant classification.

In the final analysis the essential problem of soil classification is a philosophical one connected with the relative differentiating importance of the various soil attributes. There is inherent in this the need to determine whether we should consider all the attributes at all categorical levels or only one at each level, or, more likely perhaps, accept some intermediate scheme based on the recognition that the various soil characteristics are not by any means independent of each other.

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POSSIBLE GENOTYPES CONDITIONING VIRUS RESISTANCE IN THE POTATO AND TOMATO

By E. M. HUTTON

Introduction

A number of crop plants, including the potato and tomato, are subject to substantial yield reduction from time to time as a result of virus diseases. In the potato, degeneration and loss of yield is caused mainly by the mosaic viruses X and Y and by the leaf-roll virus. Virus X is transmitted mechanically, whereas leaf-roll and Y are carried by aphid vectors. The tomato is often affected in a spectacular and devastating fashion by the thrips-transmitted spotted wilt virus. Control measures aim at eliminating both the plant reservoirs and vectors of the various virus diseases, but such measures are costly and sometimes ineffective. The ideal control method is to develop resistant varieties. For the geneticist and plant breeder to make real progress in the development of resistant types it is essential that they have some conception of the plant-virus relationship. This is essentially a biochemical relationship, as the virus which is composed of ribose nucleoprotein lives and multiplies only by using the enzyme systems and other metabolic machinery of the living cells of susceptible plants. Infection imposes a new metabolic pattern on cells resulting in the accumulation of ribose nucleo-protein and changes in the physical properties of the cell proteins. Resultant symptoms in plants may be severe although in tolerant types symptoms may be inconspicuous or lacking. Resistance to the systemic invasion of plants by viruses from their point of entry may be due to a lack of what could be called attachment factor for the virus or to an enzyme relationship inhibitory to virus development. When more is known about the multiplication of viruses in plants it can be visualised that a study of the genetics of virus resistance will consist in following the inheritance of enzymatic or other biochemical differences.

Immunity, resistance, susceptibility and tolerance

A sure basis cannot be given to the development of virus resistant varieties of potato and tomato and other crops unless the geneticist and plant breeder have an idea of the relationships existing between resistant and susceptible phenotypic reactions and can recognise resistant phenotypes or phenotypes possessing some of the genes needed for resistance. Virus resistance, like other biochemical complexes, is markedly influenced by environmental factors, particularly temperature, and by vigour and maturity of the plant. Thus it is possible for a mature plant to be fully resistant while a young duplicate is susceptible, and again a plant grown under cool conditions may be susceptible while its duplicate grown under hot is resistant. These facts emphasise the need for controlled conditions if the phenotypes in a progeny are to be accurately classified with respect to virus resistance.

Considering susceptible and tolerant phenotypes, both allow systemic invasion of the virus from the entry point and differ only in the severity of symptoms.

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There is no direct correlation between severity of symptoms and virus content so that almost symptomless and tolerant phenotypes may have a higher virus content than very susceptible ones with severe symptoms. If possible, a virus problem in a crop should not be solved by the development of tolerant phenotypes as they are often good virus reservoirs for vector transmission and provide suitable conditions for virus mutation and the genesis of more virulent virus strains. It is admitted that where resistance is unobtainable, tolerance is better than extreme susceptibility. There are instances of tolerance being linked with a low virus concentration. This factor made possible the development in U.S.A. of sugar beets which were able to produce payable crops in spite of the curly top virus which is usually so devastating.

In the potato, immunity to virus X, a rather unique condition is found in the American seedling 41956. A localised

Figure 1
Localised necrotic reactions on leaf of seedling potato 11-84 following inoculation with virus Y.

resistant reaction, often called hypersensitivity or field immunity, is typified by the reaction of the Epicure potato variety to virus X. Both these phenotypic reactions are heritable. The hypersensitive reaction, as distinct from the immune, implies that the plant tissues are very susceptible and die so quickly following infection that the virus becomes surrounded by dead tissue and so is unable to multiply. Work at Canberra has strongly suggested that this conception of hypersensitivity is incorrect and that, with the potato, immunity and localised reaction or hypersensitivity to virus X are phases of the same biochemical reaction. At present these reactions to virus are regarded as being due to different genes whereas they now appear more likely to stem from different dosages of a common major gene. It will be remembered that the potato is a tetraploid. The Canberra experiments have shown that a potato seedling carrying the immunity factor has a small number of loci in the leaves capable of keeping virus X in an active, although restricted condition, for almost a month after inoculation. Further, when two potato seedlings carrying the X immune factor are hybridised, up to 80 per cent. of the resistant or immune seedlings give necrotic reactions when inoculated with virus X under relatively low temperature conditions. On the other hand, seedlings apparently immune to virus Y have been developed from intercrossing potato hybrids possessing a localised reaction to this virus (see Figure 1). These findings support the contention that localised resistance and immunity are phases of the same reaction and are dependent on similar genes. This conception is important if a logical genotypic basis is to be developed for virus resistance in the potato.

In the tomato a relationship between immunity and resistance, as found in the potato, does not seem to exist. Among tomato species, however, phenotypic reactions which result in a degree of resistance to systemic invasion by spotted wilt occur, particularly in *Lycopersicon pimpinellifolium* and *L. peruvianum,* and in the *L. esculentum* variety Rey de los Tempranos. These resistant reactions to spotted wilt are only accompanied by necrosis under certain conditions, so that it is apparent that in the tomato necrosis is not necessary for resistance. Even in the potato, it is thought that the necrotic reaction is not a necessary part of virus inactivation but rather a side reaction to it. There is some justification for this view as it has been observed that a number of seedlings which give a localised necrotic reaction to one of the two viruses X or Y at a temperature of 60°F. to 70°F. will give an apparently immune reaction to the particular virus at a temperature of 90°F.

A study of the pattern of virus development in potato and tomato varieties and seedlings resistant to the respective viruses has given some understanding of the reactions involved so that a more intelligent approach can be made to the overall problem of the genetics of virus resistance. In susceptible phenotypes a high percentage of the points of virus entry in leaf inoculation allow the establishment and gradual multiplication of the virus. With resistant phenotypes the number of points of virus entry which allow virus establishment are reduced by at least half, and then the virus does not multiply to any extent but is gradually inactivated over a period of two to six weeks. The speed and intensity of this chain of reactions is a function of both the phenotype and virus used. The underlying gene-controlled biochemical processes which lead to resistant reactions differ no doubt in the various species. It is postulated that differences in the nuclease system causing an interruption to the development of virus occurs in resistant types. In the potato it could further be postulated that when necrosis occurs in a resistant phenotype it is due to overstimulation of a common respiratory enzyme by the particular nuclease system. These thoughts

indicate how meagre our knowledge is of what constitutes resistance and susceptibility to virus. An understanding of the broad principles involved is however necessary if we are to progress in the important field covering the gentics of virus resistance.

Genotypes for resistance to virus Y in the potato

In 1945 Cockerham working at the Scottish Society for Research in Plant Breeding reported the existence of several clones of *Solanum demissum* and *S. simplicifolium* which possessed heritable "field immune" reactions to virus Y. When the work at Canberra on the development of hybrids resistant to virus Y was commenced in 1941 it was decided to base it on varieties of *S. tuberosum*. At this time there were no varieties available with definite resistance but it had been observed that varieties differed in their reaction to virus Y, some developing a mottle and others varying degrees of necrosis with a mottle. In addition experiments had shown that necrosis reduces the virus Y concentration, and that varieties reacting with a mottle had a relatively high virus concentration. It was thought that if by suitable hybridisations the genes conditioning necrosis could be brought together in the right combination and condition, definite resistance to virus Y would result. With these ideas in mind, varieties like Katahdin, Snowflake and 41956 which reacted with a severe necrosis to virus Y, as well as with a mottle, were intercrossed. The seedlings which had the most necrotic reactions to hand inoculation with virus Y in the glasshouse were selected. The selected seedlings were then intercrossed and the process repeated for a number of generations. It was necessary to avoid selfing as the usual heterozygosity of the potato is necessary to maintain vigour and yield. Some eight generations involving 12,000 seedlings were required before seedlings with a stable and a definite localised resistance to all strains of virus Y were isolated (Hutton, 1948). As they were developed from varieties of *S. tuberosum* a number of them have yields and agronomic characters comparable with the best commercial types, but have in addition the ability to withstand epidemics of virus Y in the field.

It is difficult to define the genotypes involved in virus Y resistance but a hypothesis can be formulated in accord with the results obtained and in the light of modern research on the genetics of the potato. Cadman in 1942 at the Scottish Society for Research in Plant Breeding summarised the evidence for the now accepted autotetraploid nature of the potato, and submitted new supporting data from his own work with virus X. The results obtained at Canberra on the inheritance of virus Y resistance can also be fitted into an autotetraploid scheme in which a recessive gene in the nulliplex condition gives immunity, while its dominant allelomorph in the quadruplex condition gives susceptible phenotypes reacting with a mottle. Completing the hypothesis, it can be assumed that the simplex condition results in phenotypes with a localised reaction whilst lethal or severely necrotic phenotypes depend on the duplex condition. Varieties or seedlings which react with both necrosis and mottle would be thought to depend on a triplex condition of the gene. There is no doubt that the operation of the major gene as visualised is tempered by the influence of polygenes.

The evidence for this picture of virus Y inheritance is by no means complete. However the accumulated data support it in some of the essential details. Most of the common varieties can be classed as quadruplex or triplex for the major gene. Thus varieties like Bismarck when selfed give only phenotypes reacting with mottle to virus Y and when crossed with a necrotic reacting variety greatly reduce the necrotic reacting seedlings in the resultant progeny. Varieties like Snowflake and Katahdin can be classed as

duplex and when selected seedlings from intercrosses of these are further hybridised for a number of generations, the simplex condition causing a localised reaction emerges. The step from duplex to simplex is a difficult one genetically, but once achieved results in seedlings which give a very satisfactory number of resistant phenotypes in crosses. For example when one of these simplex seedlings was backcrossed to Katahdin 30 per cent. of the seedlings gave a localised reaction to Y. However, when this simplex seedling was intercrossed with another simplex type 68 per cent. of the seedling progeny gave a localised reaction to Y and a few seedlings appeared with an immune type reaction dependent presumably on the nulliplex condition. It will be very interesting to investigate further the supposed nulliplex phenotypes as they are an important link in the whole concept of the relationship between localised resistance and immunity.

Genotypes for virus X resistance in the potato

As stated earlier, Cadman has developed an autotetraploid scheme for the inheritance of virus X resistance in the potato. This was based on the seedling reactions in his progenies to graft inoculation to virus X, two phenotypes only being distinguished — lethal and mosaic reacting. He found that most necrotic reacting varieties were simplex for the dominant allele of a gene. It is not intended to consider the Canberra results on the inheritance of immunity and localised reaction to X at length as it is thought that it follows a similar pattern to that given for virus Y resistance. The most important concept which has been developed is the classing of localised reaction and immunity to virus X as phases of the same biochemical reaction. This is based, as stated earlier, on the observations that immunity is not absolute and that intercrosses between immune parents results in a percentage of localised reacting seedlings. On the other hand intercrosses between localised reacting types result in a percentage of immune phenotypes. It has been observed that vigour and environmental factors like temperature determine whether a particular seedling will give a localised or immune type reaction. More work is needed on this aspect to define phenotypes more accurately and so gain a better knowledge of the possible genotypes involved.

The results obtained at Canberra are based on the reactions of first generation seedlings to hand inoculation with virus X. It is considered that a better differentiation of phenotypes is obtained this way as compared with the graft inoculation technique used by Cadman throughout his work. Intercrosses between seedlings were made so that all combinations of immunity, localised resistance and susceptibility were included in the experiments. As expected, intercrosses between susceptible seedlings yielded completely susceptible progeny. When susceptible types are crossed with immune or localised ones the percentage of resistant seedlings usually varies from 3 per cent. to 26 per cent., a finding in line with the results of Schultz and co-workers (1934) in U.S.A. Intercrosses between immune and localised reacting types result in 10 per cent. to 40 per cent. resistant seedlings, which is not as high as expected. This result in conjunction with the others indicates that the recessive allelomorph of a gene in the nulliplex condition may produce immunity, the dominant allelomorph in the quadruplex condition giving complete susceptibility. It is then possible that both the simplex and duplex conditions represent types of localised reaction differentiated by inoculation at various temperatures, the triplex condition being represented by severely necrotic types. The scheme presented does not conflict entirely with Cadman's results, but seeks to give an overall picture of the genetical background to virus X resistance.

Genotypes for spotted wilt resistance in the tomato

Research has shown that various degrees of spotted wilt resistance are resident in certain lines of *Lycopersicon pimpinellifolium* and *L. peruvianum*, and in the *L. esculentum* variety Rey de los Tempranos. The highest level of resistance appears to be present in *L. peruvianum*, but difficulties in hybridising it with *L. esculentum* have prevented an assessment of its value in seedling progenies. *L. pimpinellifolium* on the other hand is highly resistant to spotted wilt in the field and is readily hybridised with varieties of *L. esculentum*, so most of the Canberra work has been done with crosses containing it. Hybrids involving Rey de los Tempranos have not been studied as yet, but this should be a fruitful line of investigation.

After some five years' work with hybrid and back crosses involving *L. pimpinellifolium* it was realised that the mode of inheritance of resistance was obscure. This was in spite of the fact that the species used were diploid and resistant seedlings were being selected in the glasshouse after carefully controlled hand inoculations with spotted wilt. It was evident that an investigation of the phenotypic reaction of parental types to the virus was necessary before any real progress could be made with the genetics of resistance.

Investigations have shown that a virus-inactivating system is present in *L. peruvianum*, *L. pimpinellifolium* and the *L. esculentum* variety Rey de los Tempranos, the most efficient one being in *L. peruvianum*. Following glasshouse infection with spotted wilt, virus concentration in the inoculated leaves of these three types is kept at a low level, whereas in a common susceptible variety like Bonny Best the virus gradually increases in concentration until it attains a relatively high level. In *L. peruvianum* the virus becomes systemic in only a few plants, but under the right conditions invariably becomes systemic in *L. pimpinellifolium* and Rey de los Tempranos, recovery and loss of the virus occurring particularly in *L. pimpinellofolium*. The whole picture is complicated by environmental factors, temperature appearing to have the most effect. It seems that relatively high temperatures speed up the virus inactivating mechanism in *L. pimpinellofolium* and Rey de los Tempranos, so that they become as resistant to systemic invasion with spotted wilt as *L. peruvianum*. An ordinary susceptible variety like Bonny Best is not affected in this way. Now that some understanding of these phenotypic reactions have been obtained it is felt that progress can be made with the study of the genetics of spotted wilt resistance. From the evidence (Hutton and Peake, 1949) so far obtained it is doubtful whether inheritance is simple. A major gene may be involved but it is more likely that a polygenic system governs resistance to spotted wilt. A linkage with small fruit size in *L. pimpinellifolium* crosses is also indicated. It is hoped that work now in progress will elucidate the genotypes conditioning resistance.

Summary and conclusions

This paper has emphasised the importance of the necrotic reaction to a virus, because its presence in a variety or allied species of a crop plant most probably indicates the presence of genes valuable in developing virus resistant or immune types of the particular crop plant. This principle has been demonstrated in the case of the potato, a crop which is heterozygous for most characters. The possible genotypes developed have been discussed in the light of modern findings on the genetics of polyploids. Where heterozygosity exists, particularly in a polyploid, a wide range of reactions to a virus, including necrosis, can often be found so that the genetical development of resistant types can often proceed as outlined. In diploids like the tomato, especially where most characters tend to be homo-

zygous, the range of reactions to viruses is considerably reduced and a necrotic reaction may not be found. In such instances a gene controlled mechanism which gradually inactivates virus as it is formed, and eventually eliminates it altogether, may be found as in certain tomato species. The possibility that the tolerance of certain varieties to virus may result from a similar mechanism must not be overlooked in the search for means of overcoming virus problems by genetical means.

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METHODS OF INCREASING ANIMAL PRODUCTIVITY

By T. J. ROBINSON

Introduction

In general the problem of increasing animal productivity may be approached along five lines, each of which is interdependent on the others. These are:—

(i) Choice of a suitable type of animal for the particular environment in which it is to be kept;

(ii) Improvement of this type;

(iii) Improvement of the environment;

(iv) Maintenance of animal health;

(v) Application of knowledge of physiology and biochemistry to raise production, sometimes by artificial means.

Choice of a suitable type of animal

In the past both the determination of a type of animal suitable for a particular environment and subsequent improvement have been largely a matter of trial and error. Now, as our knowledge of the physiology of adaptation, reproduction, ruminant digestion and so on has progressed, we are able to predict with some certainty what type of animal will be suited for a particular area and so avoid many of the costly errors involved in the old trial and error methods. In improvement of this type, too, while the science of modern genetics has contributed little more, as yet, to animal breeding than the old rule of thumb methods by which our modern breeds were established, we are now in a position to be able to predict with some accuracy what improvement can be expected under a given set of circumstances and in a certain number of generations.

Full realization that a type bred for one area, in which it excels, cannot always be transported thousands of miles to a totally different environment and still thrive, has been very slow. For many years we have seen the policy in Australia, as in Argentina and elsewhere, of importing beef bulls to run under rigorous semi-tropical conditions for which they are not adapted, and under which they deteriorate. The only solution to many problems of adaptability is to carry out breeding experiments under the conditions in which the animals are to be produced in practice. As Lee and Phillips (1948) point out, the procedures available fall into three main categories:—

(a) Selection within native types.

(b) Grading up native types with imported improved types.

(c) Development of new types from animals graded only part of the way.

An outstanding example of this latter type is the Santa Gertrudis breed of cattle developed in Texas for semi-tropical conditions, and produced from Shorthorn and Zebu stock.

Improvement of the type

It is not intended here to enter into a discussion of the various types of breeding programmes. It is desired, however,

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to stress the importance of the male, and of family rather than individual selection of the females.

Full use of the best males requires the application of artificial insemination, but here one faces many practical difficulties. To date, attention has mainly been concentrated on the use of A.I. to improve dairy herds. Any successful herd improvement programme involving A.I. *demands* that the males used should be genetically of above average merit. Locating such bulls and then being able to obtain and use them is a major problem. The first prerequisite is a highly developed herd testing programme to locate bulls capable of producing daughters of above average merit. By the time such bulls are proven they are usually at least six years old, and many will have been slaughtered, so the supply will be very limited. As a start to building up an effective A.I. service the best procedure is probably to use such tested bulls as can be obtained as widely as possible, using A.I., and distribute the *sons* of these proven bulls to selected farmers for use in their own herds by natural service. Then, by following the records of performance of the daughters of these sons of proven sires, one should be able to improve the supply of bulls of above average merit and so increase the A.I. service. This procedure has now been adopted in New Zealand.

What promises to be a major contribution of genetics to animal production has arisen from the hybrid corn work. A number of families are inbred and selected for similar or for various characters. After a number of generations and the elimination of undesirable characters, a number of fairly homozygous families is obtained. Vigour is lost and production goes down and some families die out. Families are then crossed and some combinations usually result in crosses of outstanding commercial merit. This technique is still in its infancy but some quite promising results have been obtained with poultry, for example at Beltsville, U.S.A. (Byerley, 1949). Similar programmes are now in progress with pigs, notably at Iowa and Minnesota, but results are not as yet conclusive. When one considers the application of such techniques to the improvement of sheep or cattle one is faced with the enormous practical disadvantages of the interval between generations, and the high wastage rates.

Improvement of the environment

In this category fall climatological factors and the nutritive state of the animal. In general the only solution to climatological problems lies in the use of species and breeds adapted to the particular climate. On the other hand there is often quite a lot one can do to control the nutritional environment.

The maintenance cost and efficiency of feed conversion

The object of keeping farm animals is that they shall convert food unsuitable for man into food, clothing and work useful to him. This is particularly true of the ruminant. Pigs and poultry use some foodstuffs, e.g. grain, in direct competition with man. While meat production by cattle or sheep is relatively inefficient in terms of energy and protein conversion, these animals use cheap pasture which is not utilizable in other ways, and labour costs are low. An interesting observation was made by D. A. Boyd (1951) at the symposium of the Nutrition Society of Great Britain in London in January this year. Boyd observed that from 21.7 million tons of starch equivalent fed to livestock in Great Britain annually, only 1.9 million tons of starch equivalent was obtained in animal products, an overall efficiency of 8.7 per cent. A reasonable figure to expect would be about 16 per cent. This indicates that much too high a proportion of the feed is being used for maintenance and not enough for production.

The same is true for many pasture fed animals in Australia. Attention is now being turned, particularly in Great Britain, the U.S.A. and New Zealand to

food consumption on pasture. The questions are, how much total energy and protein does a cow or sheep consume on pasture, and on different types of pasture? Also what proportion of the total food consumed by a sheep in the pastoral areas, for example, is used for obtaining its food and how much is left for production? If maximum production can be obtained from a high producing dairy cow only by supplementary concentrate feeding, can maximum growth be made by a highly improved steer or lamb on grass? Provided pastures are at an optimum stage of growth with respect to bulk, protein content and palatability, it appears that maximum, or very nearly maximum growth rates can be obtained. However, at other stages of growth, either very early in the growing season when bulk is low, or very late when the nitrogen level is low, maximum growth is not possible. The question then arises as to whether or not supplementary feeding on pasture will be a paying proposition. It is impossible to give a general answer to this. For example, if the season ends when fat lambs are not quite finished so that it is impossible to finish them on pasture, it may be profitable to add a small supplement to finish them rather than sell as stores or hold them over the dry period. The same is true for steers. It may pay handsomely to supplement 21 or 33 month old steers towards the end of the green feed season in order to finish them and avoid holding them over another year.

Problems of seasonal pasture production

Also involved in the control of the nutritional environment is pasture management. One of the major problems of animal husbandry is that set by the seasonal nature of plant growth, as the carrying capacity of an area is limited by the lowest level of feed production. Means of partly overcoming this handicap are:—

(a) Use of a form of animal production which is itself seasonal and geared to use the spring flush, e.g. fat lamb production.

(b) Zonal production, e.g. production of weaner calves for shipping to more favoured areas for growth and fattening, on the expiration of the spring flush.

(c) Use of irrigated pastures in association with annual pastures on the one property, or to fit in with zonal production.

(d) Use of special purpose pastures in areas where perennial pastures are possible. This is under investigation in New Zealand and involves the use of a number of combinations of simple pasture mixtures, designed to make maximum growth at different times of the year.

(e) Fodder conservation and supplementary feeding.

It is this last possibility which will be discussed, but first it is necessary to make the distinction between supplementary and drought feeding. The latter is feeding for subsistence or, at best, maintenance, whereas the former is feeding for production. A steer losing weight is being fed on beef steak — a rather expensive ration — and this happens every year to most beef animals in Australia. In the pastoral areas where transport is poor and seasons unreliable there is little one can do about this, except not to attempt to fatten cattle, but to use these out-back ranges as breeding grounds for beasts which at 18-21 months of age could be brought down to more favoured areas for fattening. This would avoid the acute overstocking following a series of bad years as there would be no accumulation of unfinished steers. Also the rate of production could be increased enormously due to the more rapid turnover and the carrying of a much higher proportion of breeding cows. With wool at its present price there is little incentive to do this, but if Australian beef production is to be raised, some such zonal production must be used ultimately.

In the more favoured areas general satisfaction is expressed with cattle

marketed at 2½ years or older, resulting in a slow turnover and low production. This same problem was faced in California, a country with climatic and growth conditions very similar to much of Australia. There it has been solved in three ways:—

(a) By finishing cattle at 18-21 months on irrigated pasture.

(b) By finishing cattle in feed lots using lucerne hay plus concentrates.

(c) By applying the principle of continuous growth by supplementary feeding on the range.

Of these alternatives the first has only limited application in Australia, and the second no application at the present time. However, the third alternative is worthy of some considerable attention.

Work carried out by Guilbert and associates of the University of California on the San Joaquin Experimental Range has resulted in cattle being sold fat at 21 months or at the most 33 months of age, off foothill country with a 20 inch rainfall (Guilbert, Hart, Wagnon and Goss, 1944). At weaning, when the feed is drying up, calves are held roughly to a growth curve on the principles outlined by Hammond and co-workers, so as to gain 0.5 to 1.0 lb. per day, by feeding a minimum of protein-rich concentrates in the field during the summer and early winter months. Then at the start of the next green feed season they are sufficiently advanced as to be finished, or nearly so, at 18-21 months of age when they are sold. Seasons vary, and if the animals are not quite finished additional supplementation is used to fatten. If far from finished they are sold as stores. The whole operation is geared to produce, economically, fat or nearly fat cattle at the end of two green feed seasons. Such a procedure enables the stocking of breeding cows to be kept at a maximum. Supplementation is carried out when the steers are young and the growth stimulus at its maximum, so that they need only about one-tenth the amount of supplementary feed that would be required were they not supplemented as weaners but were brought to a comparable degree of finish on concentrates and hay at 18 to 21 months.

In Australia we have an acute shortage of protein concentrates. However, we must bear in mind the possibility of utilizing non-protein nitrogen such as urea together with small amounts of grain and a much greater utilization of high protein lucerne or clover hay in implementing programmes such as that shown to be practicable by the Californian work.

Alternative uses for available feed

Attention has been turned in New Zealand to yield of animal products per acre rather than yield per animal. In the past we have spoken in terms of the Holstein-Friesian as a breed producing more milk than the Jersey. However, on a given area of land how many more Jerseys can be carried than Friesians, and what then are the relative merits of the two breeds in terms of whole milk, fat, protein and calories produced per acre? This approach has directed attention to the determination of feed consumption and efficiency of utilization in the field.

Also involved in the question of nutritional environment is the control of the plane of nutrition for a specific purpose. Thus it is fairly generally accepted that increasing the plane of nutrition before mating tends to stimulate the production of twins by ewe flocks. High feeding in late pregnancy not only assures good foetal development, but also a good milk supply. The application of such principles obviously demands adequate fodder conservation. Hammond's and McMeekan's classic work on the plane of nutrition, and the development of pork and bacon qualities in the pig needs no description.

So to sum up, the producer should aim at a profitable compromise between the ideal obtainable under optimum conditions on the one hand, and the result which will be obtained when no attempt is made to

control the animal's environment on the other. Thus, for example, we have a good idea of the optimum growth curves of pigs and cattle to produce a carcase the market wants. The object of the producer should be to approximate as nearly as possible to these growth curves. It must be a matter of compromise but the Cambridge and Californian work has shown this approach to be quite practicable, resulting in an efficient utilization of available animal food resources.

Maintenance of animal health

In this category are included control of animal diseases both of an infectious and specific nutritional nature, control of pests and so on. In Australia we have had more than our share of such problems, and while it is not intended to discuss this aspect of animal husbandry the importance of animal health cannot be overemphasised.

Application of animal physiology and biochemistry

The fields of physiology with which we are most concerned are those of digestion and absorption, notably ruminant digestion, endocrinology and environmental physiology.

Our whole concept of ruminant digestion has undergone great changes in the last two decades with the realization of the role of rumen flora in the breakdown and resynthesis of food constituents. This has led to the work in the use of non-protein nitrogen sources, such as urea, in dairy cattle feeding. The amount of urea which can be so utilized is apparently dependent on the nature of the remainder of the ration, and up to 1 per cent. of the ration can be safely fed under some circumstances. Another most interesting recent report is that inorganic sulphate may be utilised to synthesise sulphur-containing amino-acids (Bloch and Stekol, 1950).

Under the broad field of endocrinology one can consider the processes of lactation, reproduction and growth and means of controlling or altering these processes, as for example, by the administration of thyroid suppressing or augmenting substances.

A knowledge of the mechanism of milk "let down" has shown the importance of proper handling of cattle at milking. Also the development of knowledge of the synthesis of milk and the precursors necessary for this will probably ultimately result in more efficient feeding programmes. In the field of reproductive physiology the factors controlling reproductive cycles and breeding seasons are being rapidly elucidated. This enables one to determine the best times for mating and is of great help in approaching problems of infertility.

The use of the gonadotrophic hormones for the treatment of various forms of infertility, for inducing mating out of season in sheep and for increasing the proportion of twin lambs or calves has received quite a lot of publicity, but in general results have been disappointing. There is, however, one notable case where the use of gonadotrophic hormones is of great value, namely in mare breeding. Work in England has shown that injection of pregnancy urine (P.U.) will induce ovulation in mare in oestrus, usually between 24 and 48 hours after injection (Day, 1939; Davison, 1947). Insemination 24 hours after injection results in a high proportion of pregnancies to a single insemination and solves the problem of prolonged oestrus.

Also receiving attention in England and the U.S.A. is the possibility of recovering fertile ova from cattle in which multiple ovulation has been induced, and transferring them to host cows. The potentialities of such a technique are great, but so also are the practical difficulties. However, it is encouraging that a recent report in Science indicates such a calf has been born alive (Willett *et al.*, 1951).

Another application of physiological principles is the use of substances such as

thiouracil and oestrogens for fattening. Thiouracil suppresses thyroid action and when fed to animals past the period of maximum growth induces a slightly hypothyroid state, resulting in lowered metabolic rate, deposition of fat and a high efficiency of feed utilization. Oestrogens have a similar effect, presumably mediated via the pituitary.

The feeding of iodinated casein to dairy cattle has the opposite effect. The metabolic rate is increased, resulting in a temporary increase in milk yield from cattle in the declining stages of lactation.

Much less readily understandable are the results of current work on the feeding of antibiotics in the fattening of poultry and pigs. While the mode of action of such substances is unknown there is little doubt that the rate of gain and efficiency of food utilization is increased by their use, and the inclusion of antibiotics in standard pig and poultry rations in the U.S.A. is becoming a widespread practice.

For the time being, however, these artificial means of raising production should be treated with considerable reserve until we understand more about their physiological mechanisms and side-effects and possible repercussions on the health of humans consuming animal products.

Conclusions

Increase in animal productivity can best be obtained by—

(a) A knowledge of the breed and individual potentialities.

(b) Attempts to meet these potentialities in practice, as nearly as possible with the resources and knowledge available.

(c) A breeding programme to improve the breed and individual potentialities coupled with an improved environment to keep step.

These principles are not new. They are as old as animal hubandry itself. All that is new is the knowledge of the sciences of genetics, physiology, nutrition, biochemistry, and veterinary medicine which will aid in the application of these principles and so produce improvement more rapidly than in the past.

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TECHNICAL PAPERS

HYBRID VIGOUR IN TOMATOES

By K. W. FINLAY

Summary

Eleven F_1 hybrid tomatoes were produced and grown in a field trial with eleven parent varieties including a number of local Western Australian commercial selections.

Highly significant increased "early" and "total" yields were obtained from several hybrids when compared with their higher producing parent. The average increase in yield of the F_1 hybrids over their higher producing parent was 20 per cent. The hybrid Wanneroo Late x Prosperity yielded 51.1 per cent. more than Wanneroo Late, the highest yielding local commercial variety. The fruit were of excellent quality.

Some low yielding parental varieties were found to have better combining ability than higher yielding varieties.

Fruit size was found to closely approximate the geometric mean of the parental fruit sizes.

Hybrid Pearl Harbour x Rey de los Tempranos showed promise of possessing useful field resistance to spotted wilt.

The possibilities of incorporating male sterility into some of the parent varieties to reduce the cost of hybrid seed production are discussed.

Introduction

Many workers (Burgess, 1941; Meyer and Peacock, 1941; Barrows and Lucas, 1942; Larsen and Currence, 1944), in other parts of the world have carried out experiments to evaluate the possibilities of using the hybrid vigour of F_1 tomato hybrids for increasing commercial production. Apart from a small trial by I. F. Phipps (1931, unpublished), no work has been done in Australia on this problem.

The following experiment was carried out during the period 1949-50, firstly to test some of the local commercial varieties for their ability to produce useful hybrids, and secondly to see if the increased yield would be sufficient to justify commercial use of F_1 hybrid tomatoes. Although male sterile lines of tomatoes were to hand, backcrossing to local varieties was not begun until this experiment had indicated the varieties which showed promise as parents of hybrids.

Materials and Methods

Plant material

Parent varieties listed in Table I were selected on the basis of characters which would be desirable in the first generation. The varieties Wanneroo Late, Bunbury and Geraldton are local selections grown in different parts of the state as commercial crops. They all produce good yields of medium to large, smooth round fruit, but none is earlier than midseason. Wanneroo Early was chosen because of its high early yielding ability, and its large fruit, although these are rough.

As the variety Rey de los Tempranos was to be used as a parent in an independent disease-resistance breeding programme, it was used extensively in this experiment to test its combining ability by crossing it with a range of varieties.

To offset the smallness of the fruit of Rey de los Tempranos, several large fruited types such as Ponderosa and Rouge de Marmande were included as parents.

Potentate appeared to be an ideal variety for local conditions with respect to yield, fruit size and shape. To test its

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combining ability it was also included in the experiment. Because the large round fruit of Grosse Lisse are of first class quality, this variety was also included as a parent. The variety Pearl Harbour was used because of its earliness, determinate growth habit and large fruit.

The varieties Best of All, Manzana and Pan America were included in the trial, but not as parents of hybrids, so that no further reference will be made to them.

Methods

The flowers of the female parents were emasculated by hand, using a pair of fine pointed forceps. Emasculation was carried out the day before anthesis.

To ensure as large a quantity of seed from the crossed fruit as possible, pollen was collected from the male parent by means of a modified Cottrell-Dormer pollinator (Cottrell-Dormer, 1945), built for this work. By dipping the pistil of the emasculated flowers into the detached pollinator bowl full of pollen, maximum pollination was assured.

When the seedlings of the F_1 hybrids and their parents were ready for transplanting they were planted out into a quarter acre field plot, in a lattice square design. The 25 varieties (5 varieties by 5 varieties) being replicated 6 times. Within each replication the varieties were randomised and each variety was represented by twelve plants spaced two feet apart within rows, and three feet between rows — that is each variety was represented by 72 plants in the complete trial.

The 1800 plants for the trial were transplanted on January 24, 1950, into grey coastal sand, which had a relatively low fertility.

The harvest period began on the 4th April and finished on August 17, 1950.

Watering by means of moveable overhead sprinklers, was carried out on an average of twiceweekly throughout the full period of the experiment.

All plants were trained to a single stem and staked. This procedure was adopted because staking is the normal method of training in the commercial gardens in Western Australia.

Harvesting was carried out at least once a week as the fruit became red-ripe. The fruit from each short row of 12 plants was weighed and counted separately.

Results

Early yield of F_1 generation

Because of the economic importance of "early yield" of tomatoes, an attempt was

TABLE I

Characteristics of 11 *Tomato Varieties used as Parents of Crosses*

No.	Variety	Character				
		Time of maturity	Yielding Ability	Fruit Size	Fruit Shape	
12	Potentate	Midseason	Good	Medium	Round	Smooth
13	Grosse Lisse	Late	Fair	Large	Semi-round	Smooth
14	Ponderosa	Late	Poor	Large	Semi-flat	Rough
15	Rey de los Tempranos	Midseason to Late	Poor	Small	Flat	Rough
16	Prosperity	Midseason	Good	Small	Round	Smooth
17	Wanneroo Late	Late	Good	Large	Semi-round	Smooth
18	Bunbury	Late	Good	Large	Round	Smooth
19	Geraldton	Early-Midseason	Good	Medium	Round	Smooth
20	Wanneroo Early	Early	Fair	Large	Flat	Rough
21	Rouge de Marmande	Early	Fair	Large	Flat	Rough
24	Pearl Harbour	Early	Poor	Medium to Large	Round	Smooth

made to collect as many data as possible during the first few weeks of the yield period. Early yield figures were computed after three harvests (11 day period) and after a period of three weeks, shown in Table II. Analysis of variance computed for each of these periods indicates that significant differences occurred between means.

Two hybrids, Ponderosa x Rey de los Tempranos and Potentate x Rey de los Tempranos gave significantly ($P < 0.01$) increased yields over their earlier parent. All the parents of these two hybrids are late varieties (Table 1.).

Three other hybrids, Wanneroo Early x Rey de los Tempranos, Rey de los Tempranos x Rouge de Marmande and Pearl Harbour x Rey de los Tempranos gave early yields that were significantly ($P < 0.05$) higher than their earlier parent.

Rey de los Tempranos was a parent of all these hybrids which were earlier than their earlier parent. With high early yield as a criterion, therefore, Rey de los Tempranos appears to have a very good combining ability.

Only one hybrid, Pearl Harbour x Rey de los Tempranos gave significantly higher early yield than Pearl Harbour, the earliest parent in the experiment.

A further analysis of yield at the end of three weeks (Table II) shows that the hybrids Ponderosa x Rey de los Tempranos and Potentate x Rey de los Tempranos gave highly significant increased yields above their parent varieties. The other three hybrids which gave significantly higher yields after three harvests, no longer possessed any yield advantage when compared with the higher yielding parent.

This indicated that, three weeks after the commencement of picking, these early parent varieties had yielded approximately as much fruit as the F_1 hybrids, but the later varieties still lagged behind the production of their F_1 hybrids.

Total yields of the F_1 generation

The analysis of variance for total yields gave significant F values, indicating that definite differences occurred between varieties. The total yields in tons per acre of the hybrids are listed in Table II.

Of the hybrids tested, Ponderosa x Rey de los Tempranos, Wanneroo Late x Prosperity, Wanneroo Early x Rey de los Tempranos, Rey de los Tempranos x Rouge de Marmande and Pearl Harbour x Rey de los Tempranos gave increased total yields above their higher producing parent that were highly significant. Hybrid Wanneroo Late x Prosperity was the only variety to give a significantly higher yield than Potentate, the highest yielding parent.

The average increase in yield of the F_1 hybrids over their higher producing parent was 20 per cent. The hybrid Ponderosa x Rey de los Tempranos had an increase of 58.6 per cent. and Rey de los Tempranos x Rouge de Marmande 56.7 per cent. It is of interest to note that the hybrid Wanneroo Late x Prosperity yielded 51.1 per cent. more than Wanneroo Late which is the standard local variety grown commercially in the metropolitan area of Perth.

In considering the ability of different parents to transmit yielding ability, it is noted that in the combinations which significantly exceeded the yield of either parent, variety Rey de los Tempranos was a common parent in four. It seems that none of the varieties were consistently superior parents, although certain varities appear to have better combining ability than others.

Few of the parents of high yielding F_1 lines were themselves high in productivity. It is apparent that combinations must be tested, rather than predicitions made from the yield records of the parental varieties. This is illustrated by variety Rey de Los Tempranos which was low yielding but appeared to have good combining ability for high total yield, and Potentate, which was high yielding but

TABLE II

The means of 11 F_1 tomato lines and their parents for early yield in tons per acre, estimated after 3 harvests (11 days) and 3 weeks and for total yield.

No.	Cross	Early yield in tons per acre (First 3 Harvests)				Early yield in tons per acre (3 weeks)				Total yield in tons per acre			
		Parents				Parents				Parents			
		Female	Male	Mean	F_1	Female	Male	Mean	F_1	Female	Male	Mean	F_1
1	Potentate x Grosse Lisse	0.18	0.00	0.09	0.42	1.10	0.33	0.71	1.41	17.89	13.47	15.68	17.59
2	Ponderosa x Rey de los Tempranos	0.03	0.18	0.10	0.89**	0.31	0.38	0.34	1.88**	10.30	10.91	10.60	17.31***
3	Rey de los Tempranos x Prosperity	0.18	0.29	0.23	0.46	0.38	1.46	0.92	1.37	10.91	16.94	13.92	15.81
4	Wanneroo Late x Prosperity	0.15	0.29	0.22	0.66	0.65	1.46	1.05	1.82	15.63	16.94	16.28	23.62***
5	Bunbury x Potentate	0.13	0.18	0.15	0.59	0.69	1.10	0.89	1.66	13.46	17.89	15.67	17.18
6	Geraldton x Rey de los Tempranos	0.19	0.18	0.18	0.37	0.87	0.38	0.62	0.97	17.09	10.91	14.00	17.89
7	Potentate x Rey de los Tempranos	0.18	0.18	0.18	1.01**	1.10	0.38	0.74	2.37**	17.89	10.91	14.40	16.89
8	Wanneroo Early x Rey de los Tempranos	0.08	0.18	0.13	0.69*	1.22	0.38	0.80	1.39	12.15	10.91	11.53	16.10***
9	Rey de los Tempranos x Rouge de Marmande	0.18	0.34	0.26	0.98**	0.38	1.53	0.95	1.89	10.91	10.48	10.69	17.10***
10	Bunbury x Grosse Lisse	0.13	0.00	0.06	0.09	0.69	0.33	0.51	1.00	13.46	13.47	13.46	15.46
11	Pearl Harbour x Rey de los Tempranos	0.69	0.18	0.43	1.21*	2.08	0.38	1.23	2.51	5.91	10.91	8.41	15.19***

* Significant. ** Highly significant. *** Highly significant: 3.90 tons per acre.

was present in the parentage of three low yielding crosses.

Fruit size of the F_1 generation

The fruit size was determined by counting and weighing all fruit during the harvesting period. Fruit size was calculated for both early yield periods and also at the completion of the harvest period. No significant difference existed between the fruit size of any one variety when measured at any of these three times, therefore further reference will be confined to the fruit size calculated over the complete trial period (Table III).

Fruit size of hybrids 6, 9 and 10 are significantly smaller than their parental mean, and hybrids 1, 2, 5 and 7 are highly significantly smaller, the rest are not significantly different from their parental means. However, none of the F_1 fruit sizes are larger than that of the larger parent, nor smaller than that of their smaller parent, that is, the F_1 fruit size is intermediate between parental fruit sizes, but tends towards the smaller parent. This is in agreement with the findings of other workers (Groth, 1912; McArthur, 1941; Larsen and Currence, 1944). MacArthur (*loc. cit.*) reported that the size of the F_1 fruit closely approached the geometric mean of the two parents.

Powers (1941) presented evidence showing a reasonably good agreement between the observed and calculated geometric mean, however, his data showed the observed fruit size to be slightly but consistently smaller than the calculated geometric mean.

The geometric and arithmetic means for fruit size are presented in Table III. The geometric means averaged 12.7 per cent. larger than the observed.

Interrelation of early yield, total yield, and fruit size in the F_1 generation

Three important factors in evaluating commercial tomato varieties are earliness, high yielding ability, and ability to produce large enough fruit to meet requirements. Analysis of covariance was used to indicate the extent of the association of these characters in this experiment.

In determining the relationship between early yield up to 11 days (first three harvests) and total yield, also early yield up to 3 weeks and total yield for F_1 lines, correlation coefficients of —0,038 and

TABLE III

Comparison of observed fruit size in ounces of 11 F_1 tomato lines and their parents with arithmetic and geometric means.

No.	Cross	Fruit Size in Ounces						
		Parents		Observed F_1	Arithmetic Mean	% Deviation	Geometric Mean	% Deviation
		Female	Male					
1	Potentate x Grosse Lisse	2.55	4.08	2.81	3.31	—17.8	3.22	—14.5
2	Ponderosa x Rey de los Tempranos	7.57	1.18	2.69	4.37	—62.4	2.98	—10.8
3	Rey de los Tempranos x Prosperity	1.18	1.71	1.26	1.44	—14.3	1.42	—12.7
4	Wanneroo Late x Prosperity	**3.67**	1.71	2.54	2.69	— 5.9	2.50	1.6
5	Bunbury x Potentate	4.25	2.55	2.71	3.40	—**25.4**	3.29	—21.4
6	Geraldton x Rey de los Tempranos	2.67	1.18	1.47	1.92	—30.6	1.77	—20.4
7	Potentate x Rey de los Tempranos	2.55	1.18	1.36	1.86	—36.7	1.73	—27.2
8	Wanneroo Early x Rey de los Tempranos	4.16	1.18	2.30	2.67	—16.1	2.21	3.9
9	Rey de los Tempranos x Rouge de Marmande	1.18	3.28	1.84	**2.23**	—21.2	1.96	— 6.5
10	Bunbury x Grosse Lisse	4.25	4.08	3.69	4.16	—12.7	4.16	—12.7
11	Pearl Harbour x Rey de los Tempranos	2.55	1.18	1.60	1.86	—16.2	1.73	— 8.1
				Average Deviation		23.5%		**12.7%**

+0.033 respectively were obtained. There was no significant relationship between the two characters.

It may be that some degree of inherited relationship exists between early yield and fruit size. Analysis of covariance calculated to determine the relationship gave r values of —0.547 and —0.376 for early yield up to 11 days (first 3 harvests) and 3 weeks respectively. The first is highly significant and the second just below the 5 per cent. level. These relatively high negative correlations suggest difficulty in combining large fruit size and early maturity in the F_1. None of the hybrids tested combined these two characters.

Early maturing, large-fruited lines can be obtained if fruit roughness is not eliminated. Numerous early maturing, smooth, small fruited strains are known. There was an apparent close association of these characters in the materials tested.

The correlation obtained between size of fruit and total yield was +0.118 which was not significant. The absence of definite association suggest the existence of all ranges in the various hybrids.

Disease resistance

No controlled tests were made for disease resistance during this experiment, but observation showed that the hybrid Pearl Harbour x Rey de los Tempranos remained completely free from spotted wilt infection, being the only variety to do so, thus indicating the possibility of good field resistance. This resistance is being investigated further and the results will be published in a later paper.

Discussion

The value of tomato hybrids in commercial production depends on several factors. The hybrid should be superior in at least one respect to the best self-pollinated varieties. It should also possess all the favourable characteristics of size, shape, yield and earliness, equal to the standard varieties. The cost of producing seed must not be prohibitive in relation to the value of the product.

Hybrid Wanneroo Late x Prosperity produced a total yield which was 51.1 per cent. greater than Wanneroo Late, the highest yielding variety grown locally. The fruit of this cross did not differ from that of Wanneroo Late in respect to maturity. The hybrid fruit was excellent for export purposes being firm and an average of $2\frac{1}{2}$ inches in diameter, and the fruit shape was more nearly globular than Wanneroo Late.

Several other hybrids in this trial had some excellent qualities but other characteristics such as small fruit, rough fruit, etc., render them unsuitable for commercial use. They have, however, given indication of possible usefulness of some of their parental varieties in further work to be carried out.

The time required in the past to produce sufficient hybrid seed for commercial use, plus the high cost of labour for the slow and tedious job of emasculation, labelling and pollinating individual flowers had made hybrid seed production an uneconomical proposition in Australia. This has largely been responsible for the lack of interest in this method of increasing yields.

Work by C. M. Rick (1944, 1948, 1949, 1950) with male-sterile tomatoes has given a new impetus to hybrid seed production. Male sterility and the use of the Cottrell - Dormer pollinator, will undoubtedly reduce the cost and increase the production of hybrid seed per unit time of labour.

With the promising results of this first field trial, and with many lines of male-sterile tomatoes to hand, work is continuing to back-cross the male sterility factors into promising parent varieties. Further trials will be conducted to test new parental combinations suited to the local environments of the main Western Australian tomato growing regions. Knowledge gained of the parent varieties used

in this experiment will be used in these trials.

Acknowledgments

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THE QUANTITATIVE RECOVERY OF ROOT SYSTEMS IN POT EXPERIMENTS

By C. T. GATES

Summary

A method is described for the quantitative recovery of root systems in pot experiments. A multi-compartment, wooden cradle with a gauze bottom is employed for simultaneously washing a number of root systems free of soil. The method is quick and achieves uniform treatment of the root systems.

Whilst the quantitative recovery of root systems is comparatively simple for plants grown in sand cultures, it has proved difficult for soil cultures. In pot experiments there is considerably more hope of success than in field investigation, but even then the difficulties are considerable. It is quite a common practice to use spray or jet techniques in an endeavour to wash the roots free of the relatively large masses of soil, but such methods are slow and are apt to damage the root systems.

Rapid handling is an important requirement of any satisfactory method, because increasing errors in dry weight will result from respiration if the method is slow. However, the root systems should be recovered intact and there should be a minimum loss of fine roots.

In the discussion which follows, methods are described which aid in accomplishing these ends.

Equipment and procedure

Figure 1 shows a twelve-compartment cradle used in our investigations. Each compartment was large enough to accommodate one pot of soil comfortably. The containers used as pots in the investigation were No. 10 fruit cans and the size of the compartments was determined by their dimensions, as also was the number of the compartments and the dimensions of the cradle. The aim in construction was to build, within practical limits, a cradle with as many compartments as possible. The cradle was made of wood to give buoyancy; the base was made of copper gauze, approximately 2 mm. mesh, strengthened with No. 10 gauge fencing wire, stapled lengthwise at 2 in. intervals to the divisions of the cradle. The cradle was mounted by means of pulleys and counter-weight so as to move freely up or down in a tank of water, and the adjustment was such that the cradle was buoyant when in the water, but easily pushed into or out of the water or moved across the tank. With such adjustment the cradle could easily be inverted for cleaning. The tank was made deeper than the cradle, approximately three times as wide as it, and slightly longer than it.

In using the cradle, the pots of soil are first given a preliminary soaking and are then inverted in the compartments. When loaded, the cradle should sink until the bottoms of the pots just break the surface. This may occur automatically but counterweight adjustment can be made if necessary. The containers are then removed, leaving the soil just beneath the water surface. During washing, the soil mass should be kept submerged slightly, and by pushing the cradle up and down in the water, the soil will be found to fall free of the roots and pass through the gauze bottom. The root systems can then be picked out of the water by the central stalk (Figure 2), and can later be washed free of traces of adhering soil or organic matter in the laboratory.

Cabbage, tomato, clover, paspalum, and flax roots have been handled with the

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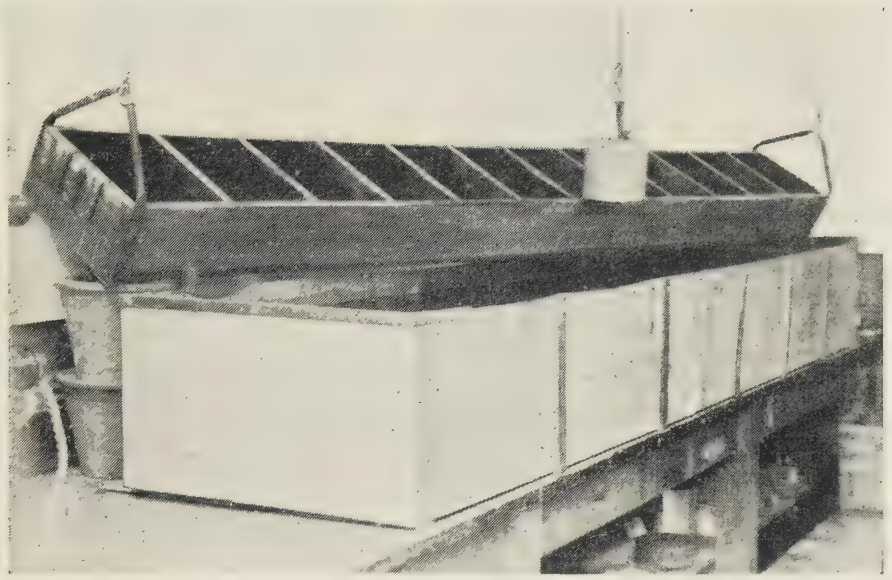

Figure 1.
The cradle tilted over the tank to show construction and counterpoise.

cradle, and the soil types have ranged from sandy loam to heavy clay, screened to pass $\frac{1}{2}$ inch mesh sieve. The washing time for the twelve samples was about 10 minutes for the heavier soils and less for sandy types. It has been found that the root systems are damaged less than with spraying techniques and that most of the finer rootlets are retained.

Removal of the container from the soil

The removal of the container from its mass of soil and roots may present a difficulty, for the wet soil mass cannot be slid from the container when under the water unless the vacuum is relieved. To avoid puncturing the base of valuable containers, it has been found that the mass may be forced out by using compressed air. One limb of a narrow U-tube of the same height as the container may be pushed into the wet soil after the preliminary soaking. Upon inverting the container in the cradle, the compressed air may be applied to the end of the free limb and, with gentle tapping, the container will lift off cleanly. A pressure of about 10 lb. per square inch is quite satisfactory. The method is greatly facilitated if a $\frac{1}{4}$-inch layer of gravel or sand be placed in the containers before they are filled with soil at the setting up of the experiment.

As an alternative method, a piece of tubing may be placed in the containers when filling with soil, so as to extend from the base to beyond the soil surface. When the container is being removed, the soil mass is freed by tapping and at the same time water flows up through the tubing as the container is lifted from the soil. The compressed air method seems the better, for it requires less preparation when setting up the experiment, less tapping is required to free the soil mass from the container, and the removal of the container is more easily manipulated.

Discussion

The method rests on certain principles and any modification that is in accord with the principles would be satisfactory. In washing soil from roots the weight of the soil tends to break them. However, this can almost be overcome by submerg-

ing the soil beneath water, so that the effective mass is decreased by the weight of the water displaced. If, whilst the soil is soaking, the water is caused to surge gently past in alternately opposite directions, the soil particles will fall free without breaking the roots.

In using the method as outlined, the correct flow must be imparted to the water as it surges through the gauze at the base of the cradle. For this reason, the cradle is suspended freely and it will usually be found best to impart a short, quick agitation in using it.

As an example of the results obtained using this technique the root dry weights, the dry weight of tops, and the root-tops ratios are cited for an experimental harvest of 14 tomato plants.

The technique has not only been used to obtain roots from pot cultures, but has also been employed to wash roots from blocks of soil brought from the field, and from seedling flats receiving different treatments. It is suggested that the method could be adapted to washing roots from soil samples taken with a Veihmeyer tube. A large number of such samples could be treated simultaneously.

TABLE I

	Root (dry weight in grams)	Total Tops (dry weight in grams)	Root Tops (ratio)
	0.945	6.096	.15
	1.114	6.048	.18
	0.982	5.864	.17
	0.876	5.433	.16
	1.158	5.704	.20
	0.983	5.671	.17
	0.981	5.869	.17
	0.948	5.301	.18
	0.916	5.841	.16
	1.109	5.926	.19
	0.977	6.120	.16
	1.052	6.300	.17
	1.227	6.322	.19
	0.853	5.649	.15
Mean	1.009	5.867	.172
S.E.	0.109	0.300	.015

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Figure 2.
Root systems as recovered from the soil by the washing technique.

TECHNICAL NOTES

THE DETERMINATION OF SULPHUR

A rapid microturbidimetric method for sulphur determination in plants and in wool has been developed.

The method involves:—

(1) Controlled digestion of the material with a 10 : 1 mixture of concentrated nitric and hydrochloric acids in the presence of sodium chloride and using selenious acid as a catalyst. Interference by selenic acid with the later sulphate precipitation is avoided by boiling with dilute hydrochloric before step (2).

(2) Production of turbidity in the sample solution from the dried digestion residues is done by its rapid addition to a super saturated solution of barium chloride. The barium chloride contains a small amount of barium sulphate, prepared by adding a few ml. of standard potassium sulphate solution to solid barium chloride and then dissolving the barium chloride in water. The presence of small barium sulphate particles in this mixture ensures a reproducible and uniform turbidity.

(3) Turbidity measurements are made using a Noblet-Forrest photo-electric absorptiometer with a Hilger H508 filter.

(4) A straight line relationship is obtained when the logarithm of the galvanometer readings are plotted against sulphur concentrations of standard potassium sulphate solutions. Sulphur content of the sample is read off from the graph.

The method has been used for sulphur estimation in *Phalaris tuberosa* L.; *Trifolium subterraneum* L.; *Cryptostemma calendulacea* (L.) R.Br. and wool. The catalyst is not used in the digestion of wool.

Using 0.1g. to 0.3g. of oven dried material it is possible to estimate between 0.01 per cent. and 1.50 per cent. sulphur in the sample with an error of 3-10 per cent. It is possible to analyse 6-12 samples per day.

Full details of this technique and a comparison with standard techniques will be published elsewhere.

A. STEINBERGS.
Division of Plant Industry,
C.S.I.R.O.,
Canberra, A.C.T.

(*Received for publication April* 10, 1951)

ERRATA

Volume 17, No. 1, March, 1951

The caption to Figure 1 in the paper by D. O. Norris, J. H. E. Mackay and G. P. Keleny entitled "Symptom expression of potato leaf roll virus as influenced by soil conditions", should be altered in the second line, from "To left of stick potatoes on low-lying area . . . " to "To left of stick potatoes on low-lime area . . ."

Volume 17, No. 2, June, 1951

In the article by Grahame Edgar entitled "Contributions of agricultural research in the livestock industries", line 6, column 2, page 92, should be altered from "Renmark Disease" to "Denmark Disease".

ANNUAL REPORT OF COUNCIL*

Annual Report of Council

Report of Council to the Fifteenth General Meeting held at C.S.I.R.O., Canberra, on March 20, 1951

Ladies and Gentlemen,

Your Council has pleasure in presenting its Report for the year ending December 21, 1950, which is the sixteenth year of Institute activity.

Office Bearers for the year were:—

President: Mr. F. W. Hicks.

Hon. General Treasurer: Mr. A. V. Hill.

Hon. General Secretary: Mr. G. A. McIntyre.

Delegates

Branch	Principal Delegates	Proxy Delegates
Q'ld	Mr. C. G. Hughes	Mr. C. S. Greenham
N.S.W.	Mr. E. J. Breakwell	Mr. C. M. Donald
A.C.T.	Mr. P. A. Reid	Mr. R. O. Brock
Vic.	Mr. R. D. Croll	Dr. I. Molnar
Tas.	Mr. D. Martin	Dr. W. V. Ludbrook
S.A.	Dr. C. G. Stephens	Mr. C. H. Williams
W.A.	Dr. T. C. Dunne	Mr. F. O. Grogan

Council met six times during the year, and while the Acting Chairman, Mr. P. A. Reid, was abroad, Dr. T. H. Harrison deputised in his place. The President was able to take the Chair at one meeting.

Fourteenth General Meeting: The Fourteenth General Meeting was held at Canberra on March 20, 1950, for the transaction of the formal business of the Institute, and the consideration of constitutional amendments. The President gave a short address on the function, organization and difficulties encountered by F.A.O. The third Award of the Australian Medal of Agricultural Science was made to Professor J. A. Prescott for his outstanding contributions to the study of the soils and meteorology of Australia.

Interchange of Personnel: Further efforts were made during the year to reduce the restrictions on interchange of scientific personnel between State and Commonwealth Public Services. A letter following up the replies received to the protest from the Joint Standing Committee of Professional Scientific Bodies was sent to the Prime Minister and State Premiers. Replies received have been circulated to Branches and will be published* in a review of Council's efforts in this matter. It was decided at the last Council meeting of the year that no further action would be taken unless the present position deteriorates.

Salaries and Status: Branch reports on Salary and Status from South Australia and New South Wales were received and circulated. The Melbourne University Appointments Board conducted a survey of salary and status of Institute members. A preliminary report has been received and it is anticipated that the final report will soon be available.

Rural Extension Services: The Survey of the position of rural extension services in the various States made slow progress throughout the year and data has yet to be supplied by two of the Branches. It is hoped that this information will be available in time to present a report for discussion at the Sixteenth General Meeting.

Agricultural Engineering: During the year the report of a Council Sub-Committee was reviewed by a Victorian Sub-Committee, and this review was subjected to Branch comment. A final report recommending a scheme for training and research has been prepared and distributed to University and Government Authorities.

* Published in *J. Aust. Inst. Agric. Sci.* 17: 1; 36 (1951).

Institute Scholarships: A proposal has been put forward that the Institute should sponsor a system of scholarships for post graduate study of Institute members. This idea has had majority support from the Branches and progress has been made with the rules for the conduct of the scheme which it is hoped will be shortly initiated.

Australian Journal of Agricultural Research: There has been no occasion since the commencement of publication of this Journal for the Institute to use its liaison with the Advisory Committee of the Journal. To date the great majority of articles appearing in the Journal have been contributed by C.S.I.R.O. officers as was understood, but the way is now open for publication of contributions of members in state services and universities, and it is hoped these will become relatively more numerous in the future.

The number of A.I.A.S. subscribers who availed themselves of the offer of reduced rates fell considerably from the first two issues. Council requested that these subscribers be circularised by slip when subscriptions become due and the Distribution Manager reports that there has since been a marked response to this reminder.

A.I.A.S. Journal: The personnel of the Publications Committee during 1950 were:—

Hon. Editor: Mr. N. M. Tulloh.

Hon. Business Manager: Mr. J. S. Orr.

Hon. Asst. Business Manager: Mr. G. Richardson.

Committee Members: Mr. P. T. Mitchell, Mr. J. A. Baker, Mr. R. D. Croll, Dr. H. C. Forster and Dr. N. S. Noble.

At the beginning of the year there was a temporary joint editorship of A. Shavitsky and A. J. McIntyre. The lag in journal publication has been progressively reduced and the journal is now appearing on schedule.

Institute Publicity: The Victorian Branch was again responsible for a special contribution to a Royal Show Supplement of one of the leading daily newspapers, and this praiseworthy effort deserves emulation by other Branches.

Membership

Membership as at December 31, 1950

	Corporate	Student
N.S.W.	218	96
Victoria	204	14
South Australia	104	25
Western Australia	95	43
Queensland	86	21
A.C.T.	58	—
Tasmania	31	—
Total	796	199

Finance: Due mainly to collection of arrears in subscriptions for 1949 income for the year rose from £496 to £959. Expenditure at £496 showed an increase of £85 over the previous year, the principal items contributing to this being a higher cost of the Journal and an item of £99 for printing and stationery, which includes the reprint of the Articles of Association. The excess of income over expenditure was £463. At the end of the year the accumulated fund amounted to £1,613.

On behalf of the Council,

F. W. HICKS,

President.

FINANCIAL STATEMENTS

JOURNAL OF THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE
VOLUME 15, 1949

Statement of Receipts and Expenditure from February 21, 1949, to June 30, 1950

RECEIPTS		EXPENDITURE	
Brought Forward	£11 18 4	Printing and Publishing Vol. 15, No. 1	£145 9 7
A.I.A.S. Subsidy	250 0 0	Printing and Publishing Vol. 15, No. 2	148 4 3
Advertising, Vol. 14, No. 3	4 14 6	Printing and Publishing Vol. 15, Nos. 3-4	220 16 4
Advertising, Vol. 14, No. 4	75 16 2	Binding Vols. 13 and 14	15 2 6
Advertising, Vol. 15, No. 1	116 19 4	Advertising Representative's Comm.	46 10 10
Advertising, Vol. 15, No. 2	60 11 2	Reprints	56 2 1
Advertising, Vol. 15, Nos. 3-4	65 7 4	Typing	4 13 0
Reprints	69 0 5	Exchange	1 18 7
Back Nos. and Volumes	5 0 11	Postage	10 5 9
Subscriptions, Vol. 15	84 14 7	Sundries	17 1 2
Subscriptions, Vol. 16	22 5 2	Balance at Bank	108 4 4
Subscriptions in Advance	1 5 0		
Interest	3 11 2		
Exchange	0 2 10		
Sundries	3 1 6		
	£774 8 5		£774 8 5

Audited and found correct in terms of our report dated July 25, 1950.

(Signed) CLEVELAND, SON AND HISLOP,
Chartered Accountants (Aust.).

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE
Income and Expenditure Account for the Year ended December 31, 1950

EXPENDITURE			INCOME		
Audit Fees		£15 16 7	Subscriptions:		
General Meetings		23 9 11	New South Wales Branch	£305 16 0	
Cost of Journal		263 14 2	Victorian Branch	189 13 0	
Petty Cash and Incidentals		84 11 1	South Australian Branch	143 1 0	
Printing and Stationery		99 3 6	Queensland Branch	121 9 0	
Honoraria—			West Australian Branch	88 18 0	
W. Ives	£3 3 0		Aust. Capital Territory Branch	66 3 0	
A. Shavitsky	6 6 0		Tasmanian Branch	25 4 0	
		9 9 0		£940 4 0	
Excess of Income over Expenditure		463 1 2	*Less* Subscriptions in Advance December 31, 1950	15 10 0	
				£924 14 0	
			Add Subscriptions in Advance January 1, 1950	4 4 0	
					£928 18 0
			Bond Interest		30 7 5
		£959 5 5			£959 5 5

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

Balance Sheet at December 31, 1950

LIABILITIES			ASSETS			
Sundry Creditors		£15 15 0	Sundry Debtors—Cost of Journal			£99 6 6
Subscriptions—Paid in Advance		15 10 0	Cash at Bank—			
Accumulated Funds—			Australian Capital Territory	£470 1 4		
Balance December 31, 1949	£1,149 17 7		Melbourne	163 0 8		
Add Excess of Income over Expenditure for the year ended December 31, 1950	463 1 2				633 2 0	
		1,612 18 9	Petty Cash		0 7 9	
			Commonwealth Bonds—			
			3¼% 15th August, 1956	£100 0 0		
			3½% 15th November, 1958	100 0 0		
			3¼% 15th September 1959	200 0 0		
			3⅜% 15th October, 1963	200 0 0		
			3⅜% 15th October, 1963	300 0 0		
					900 0 0	
			Office Furniture—At Cost		11 7 6	
		£1,644 3 9				£1,644 3 9

THE REPORT OF THE AUDITORS

We have examined the above Balance Sheet. Figures relating to the cost of the Journal for the period from July 1, 1950, to December 31, 1950, have been incorporated from statements which have not been audited. Subject to this remark, we have obtained all the information and explanations we have required, and in our opinion, such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of affairs of the Institute, according to the best of our information and the explanations given to us and as shown by the books of the Institute.

Canberra, March, 1951.

COOPER BROTHERS, WAY AND HARDY,
Chartered Accountants Aust.).

SIXTEENTH GENERAL MEETING

The Sixteenth General Meeting of the Institute was held in Brisbane in association with the 1951 meeting of A.N.Z.A.A.S. Business was dealt with in three sessions held on the afternoon of May 21st, and the morning and afternoon of May 22nd. The first session, under the chairmanship of Professor E. J. Underwood, considered the reports presented at the Annual Meeting of March, 1951, including a review of action taken on resolutions of the 13th General Meeting. Principal items were the Journal, interchange of personnel, agricultural engineering and Institute representation on the Standing Committee to the Agricultural Council. In the second session chaired by the President, the question of Institute reorganization was vigorously discussed. The principles of a report prepared by the Victorian Branch were endorsed though the proposal for a central secretariat was not adopted. A special committee was formed to make recommendations to implement these principles. In the third session, with Mr. F. W. Hicks in the chair, the Institute Scholarship Scheme, the report on Rural Extension Services, qualifications for honorary life membership, subscriptions of retired members and the general question of associate membership were considered.

The meeting was terminated by a highly successful dinner tendered by the Queensland Branch to visiting members. Following a toast to the Institute by the Minister for Agriculture, the Australian Medal for Agricultural Science for 1951 was presented to Dr. E. A. Cornish for his study on the trends of wheat yields in South Australia. Honorary Life membership of the Institute was conferred on Mr. R. E. Soutter in recognition of his outstanding work in wheat breeding. Finally the Presidential Address on the development of agricultural advisory and research services in Tasmania was delivered by Mr. F. W. Hicks. Votes of thanks to Mr. Hicks for his service to the Institute as President and to the Queensland Branch for the excellence of its arrangements for the transaction of business and entertainment of visiting members were carried with acclamation.

The following resolutions were adopted at the business sessions:

A.I.A.S. Journal

"That this meeting considers no major reorientation of editorial policy with respect to the general scope and format of the journal is necessary.

"However, active co-operation between the Editor and Sub-Editors should aim at obtaining review articles of general interest and technical articles relative to recent developments in all phases of agriculture to give wider interest for individual members of the Institute. Closer co-operation between Council and the Publications Committee should be formulated."

"That Branch Committees be requested to assist the Publications Committee to obtain advertisements in an effort to make the Journal more nearly self supporting."

Conditions of Service

"That the Federal Council be requested to investigate the possibility of having a special committee appointed by the State and Federal Governments to investigate terms of appointment, salaries, increments, benefits and disadvantages of scientific and technical personnel in government and semi-government and university employ with a view to determining if a plan such as the F.S.S.U. plan of the United Kingdom could be instituted"; and

"That the Federal Council be requested to invite other technical and scientific organizations to take part in this move."

"That the Survey of the profession of agricultural science in Australia be received and the appreciation of the Institute be conveyed to the Melbourne University Appointments Board for its valuable services in compiling this record."

"That Council be commended on its action to mitigate friction on interchange of personnel and that Council be requested to watch the position closely and take any further action necessary."

Agricultural Engineering

"That Council arrange a meeting between Professor Willis and the Victorian Sub-Committee with a view to discussing the requirements of a satisfactory course of agricultural engineering and the possibility of establishing a faculty of agricultural engineering."

Agricultural Council

"That the Hon. General Secretary write to the Secretary of the Australian Agricultural Council offering the services of the Institute to the Standing Committee, and indicating any ways in which such help might be given."

Institute Organization and Policy

"That this General Meeting, agreeing to the need for a review of the development of the Institute commends the initiative of the Victorian Branch in this direction, and whilst not adopting the proposal for a central secretariat endorses the general principles contained in the report of the Victorian Sub-Committee.

"The General Meeting, therefore, directs Council to take immediate steps designed to implement these general principles by an increase in the income of the Institute through annual subscriptions and Journal revenue so as to permit the payment of grants to Branches, expenses for Councillors and Delegates, and so as to enable Council and Branch Committees to conduct a vigorous programme of publicity both within the profession and with the general community."

Scholarships

"That this meeting recommends to Council that an approach be made to the Commonwealth Office of Education with a view to obtaining increased grants under the Commonwealth Scholarship Scheme for students proceeding to an honours year as one step in the direction of fostering post graduate training in agriculture in Australian universities."

"That this meeting supports the principle of an A.I.A.S. Scholarship Scheme, the funds for which will be solicited from outside sources," and

"That Council be directed to study ways and means whereby a scholarship scheme can be most effectively implemented taking into account the proposals already put forward by the South Australian Sub-Committee."

Overseas Members

"That the words 'in the tenure of a travelling scholarship' be deleted from the last clause of Article 6 and that the words 'for any purpose for a period of not less than twelve months', be inserted in their place."

"That this meeting directs Council to frame by-laws providing for the implementation of this clause as amended at the Branch level as far as possible."

"That the alteration of Article 6 be accepted as admissible under Article 74."

Rural Extension Services

"That the thanks of the Institute be directed to Messrs. Grogan and Hardy, and all other members concerned in the provision of the basic data of the Rural Extension Report and its collation."

"That this Meeting adopt Recommendations 1, 2, 3 and that the Agricultural Council be informed in addition to the Prime Minister and State Premiers."

"That Recommendation 4 of the Report be adopted by the meeting for the guidance of incoming Council."

Membership

"That the Branches be requested to submit their views to Council on qualifications for honorary membership."

"That this meeting ask Council to seek from the Branches their views on the desirability of either amending or deleting Clause 4 (3) of the Articles of Association and consider the question of making provision for affiliated membership."

"That Council consider ways and means whereby concessions could be made to members retiring from professional life and thereby retain their active interest in the Institute."

MEMBERSHIP

Admissions

With the recommendation of the Branch submitting the application and the Qualifications Committee, the following Applications were approved for **Corporate Membership:—**

112th Council Meeting

K. G. Beirne, N.S.W.
K. W. Russell, N.S.W.
F. H. M. Collins, N.S.W.
F. V. Bridgman, W.A.

113th Council Meeting

P. P. Gorman, Vic.
B. E. Hitchcock, Qld.
A. W. Harrison, Vic.
T. Manefield, Qld.
J. M. Stevens, Vic.
A. S. Schindler, Qld.
C. H. S. Dolling, S.A.
M. K. Maxwell, N.S.W.
Miss S. M. Murray, N.S.W.

116th Council Meeting

D. J. Kirton, W.A.
E. A. Hoffman, A.C.T.
J. J. Yates, W.A.
Miss J. N. Friend, A.C.T.
G. R. Pearce, W.A.
R. G. Coleman, W.A.
P. M. Dexter, Vic.
L. D. White, W.A.
I. M. Eadie, Vic.
N. J. Halse, W.A.
F. L. French, Vic.
A. E. Baker, W.A.
D. S. Humphreys, Vic.
J. A. C. Clayton, W.A.
N. T. Roach, Vic.
I. C. Miller, W.A.
R. E. Loder, Vic.
P. G. Canne, W.A.
C. T. Patton, Vic.
J. R. M. Wolfe, W.A.
C. G. Scarff, Vic.
K. Fitzgerald, W.A.
F. M. Martin, Vic.
P. W. Michael, S.A.
F. S. McMillan, Vic.
C. B. Wells, S.A.
D. Berry, Vic.
E. A. Jackson, S.A.
F. W. Norman, Vic.
J. Loveday, S.A.
L. F. Bartels, Vic.
P. F. B. Brownell, S.A.
N. Tyshing, Vic.
E. D. Higgs, S.A.
H. B. Kerr, N.S.W.
D. F. Smith, S.A.
C. L. Goldstone, N.S.W.
R. N. Farquhar, Tas.

117th Council Meeting

C. I. A. Beale Vic.
W. B. Tudor Vic.
J. D. F. Black Vic.
R. A. Van Baer Vic.
Mrs. E. A. Dexter Vic.
B. R. Wardle Vic.
Miss G. R. Easton Vic.
J. W. Berryman Vic.
Miss E. E. Fisher Vic.
Miss C. A. Belford, W.A.
Miss B. W. Foord Vic.
F. M. Cooke W.A.
C. R. Harding Vic.
D. P. Drover W.A.
K. B. Higgins Vic.
T. Poutsma W.A.
D. L. Honybun Vic.
B. Williams W.A.
J. K. Kehoe Vic.
M. V. Carter S.A.
F. J. E. Kendall Vic.
W. B. McGlasson S.A.
D. S. Morris Vic.
G. P. Roe S.A.
B. M. Nicholson Vic.
C. S. Andrew Qld.
P. I. Pryke Vic.
A. W. Beattie Qld.
D. A. Rooney Vic.
A. M. Evans Qld.
E. K. Simons Vic.
O. W. Sturgess Qld.
R. St. G. Summons Vic.
L. W. McLennon, N.S.W.

The following are approved for **Corporate Members** when **Student Membership** subscriptions for 1950 are received:

E. N. Fitzpatrick W.A.
L. F. Metcalfe W.A.
S. A. de Beaux W.A.
L. W. Pym W.A.

With the recommendation of the Branch submitting the application, the following applications were approved for **Student Membership:—**

113th Council Meeting

P. Arundell Vic.
J. A. Carpenter W.A.
J. E. Bromell Vic.
L. L. Chao W.A.
R. M. Butler Vic.
Miss M. L. Cleeve W.A.
N. G. Cameron Vic.
H. M. Fisher W.A.
B. R. Davidson Vic.
J. S. Gladstones W.A.
Miss M. G. Dettman Vic.
C. D. Gooding W.A
G. R. Grewar W.A.
J. W. E. Edmonds Vic.
Miss D. L. Hedges W.A.
D. H. Elvery Vic.
G. S. Keightley W.A.
M. Freer Vic.
J. W. Lewis W.A.
Miss G. B. Hotton Vic.
K. Newton W.A.
F. J. Lesock Vic.
C. M. Ralph W.A.
Miss B. M. MacIntyre Vic.
P. D. Ramm W.A.
R. D. Smith W.A.
I. A. McIntyre Vic.
Miss M. M. Snow W.A.
G. A. McKinley Vic.
Miss J. Stewart W.A.
I. D. Marshall Vic.
K. T. Whitely W.A.
Miss J. B. Naylor Vic.
D. G. Wilcox W.A.
W. T. Parsons Vic.
P. K. Herne N.S.W.
R. H. Rowan Vic.
P. V. Joyner N.S.W.

I. C. R. Rowley Vic.
Miss C. W. Straw Vic.
A. C. N. Anderson, W.A.
M. P. S. Bean W.A.
M. H. Walker N.S.W.
C. P. Madden N.S.W.
K. A. Morgan N.S.W.
T. R. Perry N.S.W.
A. V. Tims N.S.W.
R. H. Weston N.S.W.

114th Council Meeting

B. C. Jefferies S.A.
A. M. Muhammad S.A.
H. B. Brooks S.A.
P. M. Linklater S.A.
L. R. Woodhouse S.A.
A. D. Nicholson S.A.

116th Council Meeting

J. B. S. Bohanna N.S.W.
J. A. M. Brown N.S.W.
Miss B. J. Carne N.S.W.
J. D. Fahy N.S.W.
J. Giobanelli N.S.W.
D. J. Guyatt N.S.W.
M. G. Knowles N.S.W.
D. Leggo N.S.W.
M. A. Lukins N.S.W.
R. G. Marquez N.S.W.
I. McLean N.S.W.
W. R. McManus, N.S.W.
K. S. McWhirter N.S.W.
T. A. O'Brien N.S.W.
D. A. Pollock N.S.W.
C. H. Purss N.S.W.
R. J. Richards N.S.W.
K. J. Scott N.S.W.
N. S. Snow N.S.W.
B. L. Sheldon N.S.W.
J. C. Turner N.S.W.
P. G. Williams N.S.W.

Transfers

The following transfers were noted:—

112th Council Meeting

H. R. Dickinson—Tasmania to Victoria.
R. W. Jessup—South Australia to New South Wales.
W. M. Carne—Victoria to New South Wales.

113th Council Meeting

R. A. Sherwin—New South Wales to A.C.T.
A. G. Itzerott—Victoria to South Australia.
A. L. Gurnett-Smith—New South Wales to Victoria.
R. R. Pennefather—New South Wales to Victoria.
J. H. Taylor—New South Wales to Tasmania.
P. F. Butler, South Australia to Victoria.
W. D. Hardy—A.C.T. to Victoria.
A. L. Tisdall—New South Wales to Victoria.
V. B. D. Skerman—Victoria to Queensland.

116th General Meeting

A. Shavitsky—Victoria to A.C.T.
A. D. Ravina—Victoria to New South Wales.
W. R. Bettenay—Western Australia to Victoria.

Resignations

Council accepted with regret the following resignations:—

Mrs. N. Clark A.C.T.
F. W. Ratcliffe A.C.T.
A. V. Lyon Vic.
A. A. Ross Qld.
B. F. Regan N.S.W.
B. H. Arnott N.S.W.

BRANCH NOTES

New South Wales

At a general meeting on March 30, 1951, Dr. D. P. Mellor of the University of Sydney, spoke on "Some aspects of radio isotopes".

After presenting a summary of the research leading to the present state of knowledge of atomic structure and radioactivity, the speaker showed how radioactive isotopes are being used today as tracer elements in many fields of science.

Many isotopes, both stable and radio, could be used in agricultural research, although the very short half-lives of many of them limit their use. In plant physiology and soil studies it is probable that isotopes of carbon, phosphorus, calcium, cobalt, zinc and manganese will prove to be of most value.

Isotopes are used as "tracers" by incorporating them, in minute amounts, into molecules which can then be detected in subsequent changes by means of the radiations emitted. For example, the uptake and translocation of zinc in tomato plants can be followed by the use of "tagged" molecules and photographic plates. In soil studies, radio-active phosphorus has been introduced into superphosphate. By determining the amount of total and radio phosphorus in the plants, the relative amounts of phosphorus obtained from the soil and from the added fertiliser can be calculated.

A meeting on April 30, 1951, was devoted to two addresses and a film on weed control.

Mr. S. W. Preston of Timbrol Ltd. spoke on "Recent developments with chemical weed control in the U.S.A." He discussed in some detail the use of the most popular hormone weed-killers and referred to a number of new compounds which are still in the experimental stage.

Mr. K. S. Green dealt with the "Uses of weed-killers in N.S.W." He showed how the advent of hormone weedicides has brought about major changes in weed control programmes.

A sound film entitled "Killing Weeds with 2,4-D" concluded the meeting.

Queensland

At the Annual Meeting held on 21st March, 1951, the following officers were elected:—

President: Mr. N. E. H. Caldwell.

Vice-Presidents: Messrs. P. J. Skerman and C. G. Hughes.

Hon. Secretary-Treasurer: Mr. W. R. Stern.

Hon. Sub-Editor: Mr. W. W. Bryan.

Committee Members: Dr. W. A. McDougall, Dr. N. T. M. Yeates, and Mr. W. J. S. Sloane.

The President was appointed principal delegate to the General Meeting of the Institute to be held in May.

One pleasant and unusual feature of the Annual Meeting was a presentation to Mr. C. W. Winders who was for thirteen years Hon. Secretary-Treasurer of the Branch and later occupied the offices of Vice-President and President. The presentation came from senior members of the Branch who had had long associations with Mr. Winders.

The place of the usual presidential address was taken by a talk by Mr. D. Akenhead, Director of the Bureau of Horticulture and Plantation Crops, on the work of the Commonwealth Agricultural Bureaux and, in particular, of his own bureau. The growth of the work of the Horticultural Bureau is best illustrated by the number of abstracts published, which has shown an average annual increase of 25 per cent. At present, 450 periodicals, 120 books, 26 bulletins, and 180 annual reports are reviewed monthly, and there is an increase of three entirely new journals per month.

South Australia

The Annual General Meeting was held on the 16th March, when the retiring Branch President, Dr. C. G. Stephens, spoke to the Branch on "The Present State of Soil Science".

An illustrated address on "Some impressions of working abroad with F.A.O." was delivered by Professor H. C. Trumble to the April meeting of the Branch.

The July meeting was devoted to a consideration of business arising from the 16th General Meeting held in Brisbane.

Following the success achieved by the Victorian Branch in providing technical contributions to the Argus Royal Show Supplement, the South Australian Branch is now undertaking a similar assignment for the spring issue of the Chronicle Supplement.

Tasmania

The 16th Annual General Meeting of the Branch was held on Friday, 30th March, 1951.

The following office-bearers were elected for 1951:—

President: Mr. G. C. Wade.
Vice-President: Mr. T. D. Raphael.
Hon. Secretary: Mr. E. J. Martyn.
Hon. Treasurer: Mr. J. R. Rayner.
Publicity Officer: Mr. J. T. Armstrong.
Hon. Sub-Editor: Miss E. G. Wingrave.
Committee Members: Prof. H. N. Barber and Mr. D. Martin.

The retiring President, Mr. D. Martin, addressed the meeting on "The disposal of the Tasmanian apple crop".

Recently the Tasmanian Branch was called upon to present evidence to a Parliamentary Committee which is investigating the desirability of establishing an agricultural college in Tasmania. The evidence was prepared by a Branch Subcommittee and presented by the President, Mr. Wade.

The Classification and Appeals Board of the Tasmanian Public Service received a deputation from the Branch to present a log of claims on behalf of members of the Institute who are employed in the Tasmanian Department of Agriculture.

Victoria

In the closing months of 1950 the following addresses were delivered at

meetings of the Branch. On 20th October, Dr. I. Clunies Ross gave a commentary based on recent observations overseas under the title "Agricultural development in the U.K." On 27th October, Dr. E. M. Hutton spoke on "Some research work on disease resistance in crops overseas" and on 3rd November, L. T. Ross-Anderson on "Agriculture and the aeroplane". On December 1, 1950, films were shown by courtesy of the Cinema Branch, Department of Agriculture.

The Committee provided food for thought upon possible roles and activities for our Institute by arranging an address for February 2, 1951, on "The Agricultural Institute of Canada", by R. W. Blake, Agricultural Attaché to the Canadian High Commissioner.

In association with the Economic Society of Australia and New Zealand, the Branch held a buffet dinner on 7th March to welcome Mr. Colin Clark, whose stimulating address on "Australia's agricultural prospects" was delivered that evening.

An innovation which may well become an established annual event was the cocktail party to welcome to the profession the new graduates of 1950. This successful evening was held at the William Angliss Food Trades School on April 12, 1951.

At the 16th Annual General Meeting of the Branch, on May 4, 1951, the following office bearers were elected:

President: Dr. I. F. Phipps.

Vice-President: Mr. L. R. Hoult.

Hon. Secretary: Mr. J. A. Roberts.

Hon. Asst. Secretary: Mr. R. O. Kefford.

Hon. Treasurer: Mr. W. B. C. Mackie.

Hon. Sub-Editor: Mr. H. G. Turner.

Committee Members: Dr. H. C. Forster, Mr. E. Munch-Petersen, Mr. J. K. Gaunt, and Miss I. Stewart.

The Committee's report summarized an active year in meetings, social activities and Institute affairs. In keeping, was the main business at the Annual Meeting which led, after much discussion of the present and possible structure of the Institute, to resolutions envisaging bold steps to increase the scope and efficacy of Institute activity.

Another business meeting was convened on 27th July to discuss matters arising out of the Annual General Meeting of the Institute at Brisbane.

The new Committee has undertaken the compilation and distribution to members of a Branch Newsletter designed to inform members of Branch activities and to provide a medium for discussion of matters of Branch interest. The first issue appeared in July.

Western Australia

At the ordinary general meeting held on the 9th February, the guest speaker for the evening was Mr. D. Akenhead, O.B.E., Director of the Commonwealth Bureau of Horticultural and Plantation crops. Mr. Akenhead who is visiting Australia at the request of the Commonwealth Government, spoke on the growth and organization of the Commonwealth Agricultural Bureaux in general and on his Bureaux in particular.

An ordinary general meeting was held on the 11th May, when items on the Agenda for the 16th General Meeting at Brisbane were discussed by members.

At the conclusion of the discussion the speaker for the evening, Mr. A. J. Millington, gave an interesting account of his recent visit to India as a member of the Australian delegation to the Pan-Indian Scientific Conference at Bangalore.

With the aid of some excellent kodachrome slides, Mr. Millington described the many research institutions visited, the various agricultural industries and the immense organization of extension workers throughout India and Ceylon.

The Annual General Meeting was held April 17, at 5.30 p.m.

Office Bearers elected for 1951 were:—

President: Mr. L. C. Lightfoot.
Vice-President: Mr. R. Smith.
Hon. Treasurer: Mr. P. N. Forte.

Hon. Sub-Editor: Mr. R. F. Doepel.
Hon. Secretary: Mr. H. G. Cariss.
Hon. Asst. Secretary: Mr. S. E. Hardisty.
Committee Members: Mr. A. J. Millington, Dr. L. C. Snook, Mr. A. W. Humphries, Mr. S. T. Smith.
Hon. Auditors: Dr. W. Samuel, Mr. C. F. H. Jenkins.
Students' Representative: Mr. B. F. Carlin.

Dr. T. C. Dunne as immediate Past President is also, ex officio, a member of the Committee.

The business session was adjourned for a buffet tea, and following this the retiring President, Dr. T. C. Dunne, delivered his Presidential address on: "Land development investigations in Western Australia."

An ordinary general meeting of the W.A. Branch was held on the 22nd June when the Branch Delegate's Report on the 16th Annual General Meeting at Brisbane on May 21-22nd was presented to members.

The rest of the evening was devoted to an address by Dr. D. H. Curnow on "Impressions of research in England and the U.S.A." Dr. Curnow, a biochemist at the Animal Health and Nutrition Laboratories of the State Department of Agriculture, returned from England last year after working for three years in the Courtauld Institute of Biochemistry, London. He also visited the Sloan Kettering Institute for Cancer Research in New York.

Mr. P. N. Forte addressed members at the meeting of the W.A. Branch held on 20th July. Mr. Forte, Senior Entomologist in the State Department of Agriculture took as his subject "A discussion of experimental methods in entomology" and dealt in particular with the Buffalo Fly and the Mealy Bug.

SOILS OFFICER, DEPARTMENT OF AGRICULTURE

Applications, addressed to the Secretary to the Public Service Board, Public Offices, Treasury Place, Melbourne, C.2., and accompanied by evidence of experience and qualifications and a statement of date and place of birth, are invited for the abovementioned position up to Saturday, the 27th October, 1951.

Yearly Salary: £917, minimum; £969 maximum. (Including cost of living adjustment.)

Duties: Under general direction, to control soil surveying parties and to investigate soil problems in the field and laboratory.

Qualifications: To hold a Degree in Science or Agricultural Science, or equivalent qualifications and to have had considerable experience in soil chemistry and in soil surveying.

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PRESIDENT, 1951 — J. GRIFFITHS DAVIES

The President of the A.I.A.S. for 1951-52 is Dr. J. Griffiths Davies, Assistant Chief of the Division of Plant Industry, C.S.I.R.O. Dr. Davies graduated in the Faculty of Science of the University of Wales, Aberystwyth, with First Class Honours in Botany, and completed his post graduate studies at the Welsh Breeding Station.

He was appointed to the staff of the Waite Institute late in 1927 and arrived in Australia in 1928. Initially working in natural pastures, he was later concerned with developing pastures for Mediterranean climates and particularly with their management under grazing.

In 1938 he transferred to Canberra as Senior Agrostologist in the Division of Plant Industry. Under his direction the Agrostology Section of the Division has become the major unit in pasture research in Australia. He represented Australia at the Eighth Genetics Congress in Sweden in 1948.

Dr. Davies is a foundation member of the Institute and was A.C.T. Branch President in 1940.

PERSONAL

Australian Capital Territory

Mr. W. D. Hardy has been promoted to Principal Investigation Officer in the Land Use Section, of the Bureau of Agricultural Economics, Canberra.

Mr. F. O. Grogan has been promoted to Principal Investigation Officer in the Cost and Special Enquiries Section, of the Bureau of Agricultural Economics, Canberra.

Mr. E. J. Johnston, formerly of the Soils Division, C.S.I.R.O., has been appointed Investigation Officer in the Land Use Section, Bureau of Agricultural Economics, Canberra.

Mr. D. D. Shaw has been promoted to Research Officer in the Land Use Section, of the Bureau of Agricultural Economics, Canberra.

Dr. D. O. Norris, of the Division of Plant Industry, C.S.I.R.O., Canberra, left Australia in January, 1951, for a tour of the plant pathology and virus research institutions of U.K. and U.S.A. Dr. Norris will be absent from Australia for approximately twelve months.

Dr. E. M. Hutton, of the Division of Plant Industry, C.S.I.R.O., has been awarded a D.Sc. from the University of Adelaide for his research on resistance to virus diseases of plants.

Mr. T. Strong has been appointed Director of the Bureau of Agricultural Economics, Canberra.

Mr. P. A. Reid has been appointed Acting Assistant Director of the Bureau of Agricultural Economics, Canberra.

Mr. G. P. Phillips has recently returned from overseas, after studying at Harvard University, under a Commonwealth Fund Service Fellowship.

New South Wales

Mr. C. G. Savage recently retired from the position of Chief of the Division of Horticulture in the N.S.W. Department of Agriculture. At a farewell gathering of Departmental Officers, the Minister, the Hon. E. H. Graham, paid tribute to Mr. Savage's work in the development of the State's horticultural industries. *Mr. H. Broadfoot* has been appointed as successor to Mr. Savage.

Mr. A. V. Costin was recently awarded a Services Canteen Trust Fund postgraduate scholarship for work in England and possibly Sweden, in problems of soil science and ecology.

Miss Hilary Purchase left in January for Rothamstead Experimental Station where she will carry out investigations on root nodule bacteria. The work is being supported by a grant from the Agricultural Research Council of Great Britain.

Dr. F. T. Bowman has been appointed to the position of Principal Fruit Officer (Research) in the Division of Horticulture, N.S.W. Department of Agriculture.

Mr. B. Owen French, Fruit Officer (Research), of the same department, recently returned from a six-months visit to the U.S.A. and Canada in connection with horticultural research. He has since been appointed manager of the Yanco Experimental Station.

Dr. C. J. Magee, Chief Biologist of the N.S.W. Department of Agriculture, has returned from Borneo, where he has been investigating the problem of Bunchy Top disease in Manila hemp.

Queensland

Mr. R. A. Paul, of the Western Australian Branch, has come to Queensland to take up the position of Director of Dairy Field Services in the Queensland Department of Agriculture and Stock.

South Australia

It is with great pleasure that Institute members throughout Australia convey to *Mr. A. G. Strickland,* Chief Horticulturist,

Department of Agriculture, South Australia, their sincere congratulations for the well-deserved honour bestowed upon him in being awarded the C.B.E. in the recent King's Birthday Honours list.

Tasmania

Since the last notes the Tasmanian Branch has lost one member, *Mr. H. R. Dickinson,* by transfer to the Victorian Branch where he has joined the Victorian Soil Conservation Authority as Senior Conservation Officer.

Two new members have, however, joined the Branch—*Miss E. G. Wingrave* by transfer from the N.S.W. Branch, who has been appointed to the Plant Pathology Division, Department of Agriculture; and *Prof. H. N. Barber,* of the University of Tasmania, who has recently become a full member of the Institute.

Victoria

Professor S. M. Wadham was ill and spent some weeks in hospital in March this year. He has again been ill, but is now convalescing in the country. All will wish him a speedy and complete recovery.

Mr. C. P. Goulding has been appointed Manager of the State Research Farm, Werribee.

Mr. F. Skaller has been given leave for one year from the C.S.I.R.O. Poultry Research Centre, Werribee, to take up an F.A.O. assignment in Pakistan. His work on poultry breeding has been approved by Melbourne University as qualifying him for the degree M.Agr.Sc.

Western Australia

Mr. A. J. Millington, Merchants' Agricultural Research Fellow in Plant Breeding at the Institute of Agriculture, University of W.A., was appointed Australian Delegate to the Pan Indian Ocean Scientific Congress that was held in Bangalore, India, during January this year.

Dr. D. H. Curnow, of the State Department of Agriculture, has recently returned from England after being engaged there for three years on research at the Courtauld Institute of Biochemistry, Middlesex Hospital, London. Dr. Curnow, who was awarded a Hackett Research Studentship by the University of W.A. in 1947, gained his Ph.D. at the London University.

Mr. M. Cullity, Superintendent of Dairying in the State Department of Agriculture, received an allocation under the Commonwealth Dairying Efficiency Grant to study abroad, and left for Europe on the 23rd April. He expects to be away from Australia for about six months and will visit agricultural colleges and research institutes in Western Europe and the British Isles.

Mr. E. R. Watson, formerly Plant Geneticist in the State Department of Agriculture has resigned from this position to take up an appointment as Officer in Charge, "Glen Lossie", C.S.I.R.O. Field Station, at Kojonup, in the South West of W.A.

Dr. G. L. Sutton, formerly Director of Agriculture in Western Australia, was made a companion of the Order of St. Michael and St. George by His Majesty the King in January this year for services rendered to agriculture in this state.

OBITUARY

News of the death of Mr. R. C. Scott has been received with deep regret by members. Colin Scott was born in South Australia and gave a life-time of service to the development of its agriculture; firstly, as a wheat breeder and experimentalist and latterly, as Chief Agricultural Adviser. He earned the widest respect of the farming community and his professional colleagues, and his passing leaves a gap in our ranks.

REVIEWS

JAN INGENHOUSZ — PLANT PHYSIOLOGIST: WITH A HISTORY OF THE DISCOVERY OF PHOTOSYNTHESIS

By HOWARD S. REED

(Chronica Botanica Co., Waltham, Mass., U.S.A.; 11: 5/6, 1949. *Price* $3.00. *N. H. Seward Pty. Ltd., Melbourne C.*1., *Vic.)*

Botanists owe "Chronica Botanica" a debt of gratitude for this reprint of Ingenhousz's major work, which in spite of its importance in scientific history is by way of being a rarity. Jan Ingenhousz, a Dutch physician at the Austrian court in the eighteenth century, had wide interests in the developing science of his day. Stimulated by some of the discoveries of Priestley on the chemistry of gases, he spent a vacation in England studying the gaseous exchanges of plants. The book from which this is reprinted was the result. This whirlwind investigator, who proudly claims to have completed five hundred experiments in three months, reached epoch-making conclusions —namely, that the green parts of plants purified the air in light, but rendered it noxious in darkness. The popular belief that to keep plants overnight in a sickroom is dangerous can be traced to Ingenhousz; but he also occupies an honoured place in the line of investigators of photosynthesis, and apart from Stephen Hales probably did more experimental work than any other plant physiologist of his century.

This reprint contains his conclusions *verbatim*, but none of the descriptions of his experiments which formed a protocol in the original. Prefatory material concerning Ingenhousz's life, times and work is contributed by H. S. Reed, who also has appended supplementary notes to many of the chapters. Some of these form glosses on the text, and some include additional material from other writings of Ingenhousz or of his contemporaries. Others, however, consist of accounts of some recent work on photosynthesis, often not very happily selected and not very apposite to the Ingenhousz text. One often wishes that Reed had allowed Ingenhousz to speak for himself more — that some of these rather irrelevant notes had been replaced by a selection from Ingenhousz's protocol of experiments. Another feature that could, one feels, with advantage have been included is a complete bibliography of Ingenhousz's works, or at least those dealing with plant physiology.

The book, though in paper covers (it forms a double issue of the journal "Chronica Botanica"), is well produced, and is illustrated with a number of plates including portraits of Ingenhousz and facsimiles of various documents. Doubtless these plates have helped to inflate the price, which is extremely high for a book of just over one hundred pages. —D. W. GOODALL.

D.D.T. AND NEWER PERSISTENT INSECTICIDES

By T. F. WEST and G. A. CAMPBELL

(Second Edition Revised. Chapman & Hall, London, 1950. 632 *pp.,* 13 *plates and numerous tables. Price* 78/6.

The first edition of this book was published in 1946 and dealt with the literature on D.D.T. published up to the end of 1944. It comprised 301 pages. The second edition has been expanded to 632 pages, the increase being due to consideration of the literature for 1945-46 on D.D.T., B.H.C. and a few other "newer" insecticides. Chapters I and II which deal with the discovery of D.D.T. by Dr. Muller in the Basle Laboratories of J. R. Geigy Ltd. and with the manufacture and chemistry of D.D.T. respectively, have been rewritten. Changes have also been made in the plates and of the thirteen plates which appeared in the first edition, only four have been retained.

The remaining chapters of the book detail the literature on D.D.T. in respect of its toxicity to animals, its use against plant and animal pests, the various methods of application and its effect on wild life, on beneficial insects and on plants. The final chapter deals with B.H.C. and some of the other modern insecticides, such as, chlordane, toxaphene, T.D.E , certain alphatrichloromethyl-substituted benzene derivatives and Insecticide S.K.

The reviewer has two major criticisms of this book. In the first place, the book was published in 1950 yet only literature to 1946 has been dealt with and there has been tremendous progress in insecticide research and application since then. The authors explain this as due to difficulties in publication and as an alternative have included a list of references up to 1948. The final chapter, on newer insecticides in particular, under these circumstances, becomes of little value.

Secondly, the reviewer feels that some attempt should have been made to give a critical review of the literature and not simply to list each worker's results, as has been done. It is felt, for example, that by 1946 the analysis of D.D.T.

was sufficiently well developed for the section dealing with this aspect of D.D.T. to have been dealt with in this manner. A brief summary at the end of each chapter would have served a good purpose.

It is obvious that the authors have been very conscientious in their exploration of the literature and, if the sections in which the reviewer is personally interested can be taken as an example, there are few references of any importance that have been overlooked. The book would find a useful place in the reference library of the research worker interested in insecticides.

F. H. S. ROBERTS.

BEEKEEPING — CRAFT AND HOBBY

By A. R. CUMMING and MARGARET LOGAN

(First Edition. Oliver and Boyd, Edinburgh and London, 1950, *pp.* 157, *Price* 10/6 *stg.)*

The Australian reader must treat all British books on bees with a considerable amount of reserve due to the great differences in climate and flora in the two countries. This book, however suffers only slightly from this "defect." The authors have given a good, though necessarily brief, outline of beekeeping practice, essentially for the amateur with only a few hives.

The information is well up to date, as instanced by the notes on von Frisch's work on the dance language of the bees; Russian work on training bees to visit special flora; and color sense in bees.

A wide field is covered beginning with anatomy and behaviour of bees, life cycles and colony organization. A somewhat skimpy chapter on the earliest historical references to honey and bees might have been omitted without loss from a book such as this. The types of hive used in Britain are fully discussed but the only one of interest to us would be the Langstroth. The glossary of terms will prove useful to the novice, although there is some slight variation from local terminology. The list of necessary equipment is somewhat elaborate and certain items, such as carbolic cloth, are rare here. The seasonal management outlined needs some modification to fit in with Australian conditions; this applies especially to wintering.

Swarming and nucleus management are well treated, and a useful introduction to queen rearing is included together with some of the chief methods of introducing queens. The chapter on heather honey is interesting to Australians from the academic point of view only. Methods of extraction of honey and wax are outlined, but the suggestion that sticky cappings be left out in open vessels for the bees to clean must be deplored, as this is the quickest and surest method of spreading disease through an apiary and even a district, as well as inducing robbing. The section on out-apiaries will prove useful to prospective beekeepers living in congested city areas. The benefits of beekeeping as a sideline could have been stressed somewhat more.

The diseases and pests are dealt with rather too briefly for such an important subject. On the question of American Foulbrood, it should be pointed out that destruction by burning of all infected bees and materials, under the supervision of a government apiary inspector, is compulsory by law in this country. Sulphathiazole treatment is not sufficiently reliable and the shaking method has proved unsatisfactory.

The summary of beekeeping practice at the end of the book is a very useful and commendable innovation. The layout of the book with subheadings and divisions makes it easily read and facilitates quick reference.

The book might well be recommended for the amateur bee-keeper's library, but will not replace such classics as "The Hive and The Honeybee," and A.I. Root's "A.B.C. and X.Y.Z. of Bee Culture."

D. F. LANGRIDGE.

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